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THE

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ELECTRIC TRACTION ON STEAM RAILWAYS.

PROF. CARUS WILSON has recently given some very interesting figures regarding the adoption of electric traction by Italian railways. The electrification of main line railways is a subject which we have frequently had occasion to refer to in connection with Mr. Langdon's presidential address to the Institution of Electrical Engineers, and the papers of Messrs. Mordey, Jenkin, Swinburne, and Cooper.

It may, therefore, be of interest to investigate how far the Italian main line railways have really adopted electric traction, and how far the conditions that there obtain can be held to justify the adoption of such systems on our main lines in this country.

Two companies, the "Rete Adriatica" and "Rete Mediterranea," operate the greater part of the railway system in Italy. The railways themselves are still owned and are leased to the above-mentioned operating companies for a term of years expiring in 1905. The mileage operated by each company is about the same, and in the neighbourhood of 3,600 miles. Besides the main line railways there exist a series of light railways, a large portion of which are at the present time either operated by, or being converted to, electric traction. Most of these light railways radiate from the large industrial centres in the north of Italy, and in many cases have become practically interurban lines. Thus a line 20 miles long unites Pavia and Milan; another connects Brescia and Mantua, and is 43 miles long.

A glance at the maps given in Prof. Carus Wilson's paper will show how serious the competition of tramways and light railways must be. This competition, in conjunction with the great cost of coal suitable for burning in locomotive boilers, and the large water-powers which are to be found in Northern Italy, has caused both the Italian Government and the railway companies to most seriously consider the possibility of and the advantages to be gained by the introduction of electric traction on at least some of their main lines.

We give a brief *résumé* of what has so far been done. The Adriatic Company has agreed to allow a separate company, specially formed for introducing electric traction on Italian railways, to operate electrically the existing lines between Lecco-Collico, Collico-Chiavenna, and Collico-Sondrio. The power is supplied by the river Adda, from a station at Morbegno, situated above Collico, and near the centre of the system. The electrical portion of this plant was entrusted to the Schuckert Company, of Nuremberg, who were originally interested in the promotion of the electric traction company already mentioned. The line itself, and the rolling stock, were entrusted to Ganz & Co., who specially evolved what is commonly known as the Ganz system, which was so much discussed during the now famous arbitration between the District and Metropolitan District Railway Companies. The length of the line to be operated

electrically is 66 miles, and the power plant generates three-phase current at 25 cycles and 22,000 volts, which is transformed down to 3,000 volts for use on the line. This line should have been opened over two years ago—a formal opening was announced last Spring, but had to be put off, as the trial had so far not been satisfactory. At present goods trains are worked at night by means of electric locomotives, which, however, are not operated on the Ganz cascade system. The passenger trains are still run by steam locomotives. A special signal system of the most complicated automatic kind has been introduced, and is expected to work satisfactorily. This portion of the work was put in by the Adriatic Railway Company, and Messrs. Ganz are in no way responsible for it. The passenger carriages have accommodation for 56 people, and weigh 53 tons each. They are very handsome and well built, and are equipped with Messrs. Ganz's cascade system. No practical results have as yet been obtained, and it is very doubtful as to when the regular passenger service is to be operated electrically. Hence, as far as the Adriatic Company is concerned, it may be stated that they are experimenting, and have arrived at no decision as to future policy.

As regards the line itself, it is simply a tourist one, having a good traffic in summer and carrying passengers who have crossed the Alps from Switzerland or the Tyrol from Chiavenna or Sondrio to Milan.

The Mediterranean railway is equipping electrically the whole of the line from Milan to Gallarate, and thence to Varese, Porto Ceresio, Saveno and Arona. The total length of the line is 81 miles, and the whole distance is single track except the length from Milan to Gallarate, which is double. The power house is at Tornavento, about 7 miles from Gallarate. A temporary steam plant, which will later serve as a reserve, is at present supplying the power. Water power will eventually be used, the water being taken from the river Jeuno. Three-phase current at 12,000 volts and 25 cycles is used for transmission, this being transformed by means of static transformers and rotary converters to a 650-volt continuous current, at which pressure it is sent to the third rail. The motor cars on the Varese line weigh 40 tons unloaded, and have accommodation for 63 passengers. The goods traffic is to be hauled by electric locomotives. This line, like the one on which the Adriatic Company is experimenting, is a tourist line, and is in no way comparable with our main lines in this country.

As electric trains have only been in operation for a few months on this line, it is quite impossible, as all those who have experience know, to draw any conclusions from such a short period of operation as to the real cost of working, the probable receipts, or whether the results anticipated have or have not been obtained, and the results of at least two years will have to be available before conclusions of any real value can be obtained.

But Prof. Carus Wilson evidently does not think so, and as no figures are as yet available, starts to work out what it should cost to operate the Milan-Varese line by comparing it with the City and South London line, and by making various other assumptions of a similar nature. Thus he is able in the conclusion of his paper to arrive at what appears to be the desired result, viz., that electric traction on our main line railways is not only a desirable thing, but one that should be immediately contemplated.

As regards the necessary increase in traffic, the same methods of estimating are adopted, and the estimate as regards the cost of operating trains electrically is taken as already obtained. Even under such favourable conditions it is shown that the traffic will have to be doubled to pay expenses.

Even should the experiments on the Italian railways prove the success we hope they may, it does not follow that this will be an argument for operating our own main lines electrically. It should also be noted that in the case of the lines between Milan and Genoa, and Milan and Chiasso, which are the most profitable and have the heaviest traffic, no suggestion has yet been made that they should be converted to electric traction. Since the electric traction service has been inaugurated on the Varese line the number of trains has been nearly quadrupled and the average speed nearly doubled. The average speed for express trains when operated by steam was 25 miles an hour, and for ordinary passenger trains 16 miles per hour, and the number of trains each way per day was eight. This increase of travelling facilities could have been carried out had steam locomotives been retained.

The first portion of Prof. Carus Wilson's paper is descriptive of the two lines, Milan-Varese—Porto-Ceresio and Lecco—Sondrio, both of which have been described in detail in the technical press.

The map showing the large extent of light railways and tramways which exist is of great interest, as well as that which shows the railway connections in the neighbourhood of Milan ; so also are the figures of working costs of the existing Italian steam railways ; but the bulk of the paper consists of estimated figures, which are not reliable guides as to what may really be expected in this country, and should not be taken seriously by railway men.

We fully concur with the author when he states "that the change from steam to electricity should not be made unless the increase in traffic may reasonably be expected at least to cover the increased cost of running, and the interest on the capital expenditure." It is to avoid excessive and hasty conclusions that we have taken up a well-defined position as regards the electrification of our main line railways—and to counteract the harmful influence which will, undoubtedly, be exercised by the daily Press, which already appears to have decided that steam traction is doomed, and that the days are over when locomotives shall carry their own fuel or generate their own power.

The outcome of all the recent papers and the extended discussions on electric traction on our main line railways before the various Institutions, has been to confirm us in our conviction that with our present knowledge we are quite unprepared to undertake the electrification of our main lines. It has not been shown that it would pay were it done, and how to do it seems entirely beyond our present perceptions.

It would appear to us that more practically useful results would have been obtained had the various writers on this subject considered the important question of suburban lines in and round our great manufacturing towns instead of speculating on an uncertain future. On urban and suburban lines the case is quite different : there is no doubt as to system or as to the advisability—nay, actual necessity—of changing our existing methods. The traffic is ready made, awaiting the greater facilities which electricity can furnish on short journeys. Then there is knowledge and experience available to point out the way in which the work should be carried out, and to foretell accurate results and capital expenditure. Here is the field that should occupy the immediate attention of electric

traction engineers and practical railway men, and it is along these lines that the problem of electric traction on our railways should be attacked.

The Human Brain as a Coherer.

Dr. Chunder Bose has demonstrated the existence of some remarkable analogies between the behaviour of the coherer under the influence of electric waves, and that of the nerves of vision under the influence of light waves, which are now known to be electric waves of extremely high frequency. He showed that the oscillatory nature of "after images" in the eye was completely analogous to the oscillatory conductivity of certain inorganic substances when used as coherers, and Branly and others have shown that in other respects the action of the coherer and of the nervous system are remarkably similar.

The intermittent nature of the discharge in a flash of lightning makes it a powerful source of electric waves, and it must often have occurred to persons acquainted with Bose's experiment that lightning discharges might exercise some influence on the nervous system even when the flash itself was invisible. It is a well-known fact that certain persons are abnormally sensitive to the approach of thunderstorms, and cases are even recorded where convulsions and death have resulted. These effects have usually been attributed to panic or exaggerated fear of being struck by lightning, but Mr. A. Frederick Collins describes in another part of this issue some remarkable experiments, which appear to demonstrate that the influence of lightning discharges on the brain may be as much beyond the control of the will as the effect of light on the eye.

Mr. Collins happened to be making experiments on a freshly-prepared human brain, with the view of showing that its substance acted as a coherer. Two isolated needle points had been inserted into the substance of the brain with the object of measuring the resistance between the points by a Wheatstone bridge. To his astonishment he found that he could not balance the bridge arms. After an approximate balance the needle suddenly swung to *plus* without any apparent cause, showing hundreds of ohms too much, and then made an immediate second deflection to the *minus* side, showing hundreds of ohms too little. This state continued a few minutes, when a peal of thunder revealed to him the cause of the puzzling behaviour of his galvanometer needle; it was due to the approach of a thunderstorm. As the storm approached the deflections grew more and more pronounced, so that there could be no doubt that the disturbance was due to it. To exclude the possibility that the deflections were due to the effect of the electric waves on the galvanometer system, a 1 ohm coil was measured, and in this no difficulty was encountered. When the storm was at its height a telephone receiver was substituted for the testing set, and through it and the substance of the brain came sounds like the cooling of a piece of red-hot metal quickly submerged in water.

Besides these experiments on the cohering effect of lightning on the brain, which he was fortunate enough to have the opportunity of making, Mr. Collins has also made a valuable series of tests on different parts of the brain with Hertzian waves generated by an induction coil. He claims that his experiments have shown that the grey matter is more susceptible of the impressions than the white tracts, consisting of nerves or conductors, and that the granules of the rust-coloured layer are the most sensitive of any portion examined.

Mr. Collins's experiments must be of great interest and very suggestive to physiologists as well as to physicists. There are, however, many gaps to be filled up by laborious and careful experiment before his thesis can be fully accepted.

RAILWAY BLOCKS AND TELEGRAPHS: RECENT PRACTICE.

The paper read by Mr. A. T. Kinsey at the meeting of the Dublin Section of the Institution of Electrical Engineers on the 17th ult. is of considerable interest as a record of practice in Ireland, but is not of so comprehensive a character as its title would seem to indicate.

Speaking generally of the principles of block signalling, the author notes the imposition of a space limit between trains, the differences in the limits at various points, and the elasticity given by the use of switches to meet varying conditions of traffic. Some of the author's statements, however, must not be taken too literally, since we find him saying, without any qualification whatever, that "one train cannot overtake or meet another, as one train only is permitted to enter a block section at a time." It is true the rules do not give permission, except under special circumstances, but one train has overtaken another, and trains have met in the same section, both with and without the permission of the operators. The same thought appears in the curious statement that the cost of block working on double lines must not be considered "all loss," to be tolerated only on account of its "absolute safety." It hardly requires to be said, at this time of day, that the safety of the system depends quite as much upon the operators as upon the apparatus in the present method of working. To say that certain eventualities are impossible, whether with reference to the results to be achieved as a whole, or to the action of any part of the apparatus, is liable to give rise to misconception unless qualified.

Mr. Kinsey would almost appear to consider the block a necessary evil, and, as the maintenance of the signal cabins is such a considerable item of the working expenses, "the fewer of them the better for the dividend, *provided that the traffic be smartly handled.*" The italics are ours. Considered as a general statement that operating expenses should be kept to the minimum, no exception need be taken to the observation quoted. It is, however, undoubtedly true that traffic is more smartly handled, and the capacity of a line immensely increased by the use of the block system, and its value becomes more and more apparent as the traffic of a line grows. The load factor of a railway is of the utmost importance, and, probably, is only just beginning to be fully realised. In view of the fact that the road bed and its appurtenances are by far the most costly part of the equipment of a railway, it is desirable to obtain from it the greatest possible "duty."

Only in the neighbourhood of large towns, where there is a considerable suburban traffic, is the load factor of decent proportions, and in such situations the value assigned to the block system is apparent from the short sections employed. The only limits to this increase are the differences in speed and the provision of adequate braking power. Mr. Kinsey admits that "some economy" may result from the operation of the block system, "as a driver knowing that he has a clear road until he reaches the next section can make the most of it." But railway traffic is run to a time schedule in all but a few unimportant instances, and the opportunities for "making the most of it" are not numerous on the line, and even they are not often taken advantage of. The department where "the most is made of it" in this sense, is that in which the time table is made up, and traffic arrangements made generally, and it may be said that without the high degree of certainty ensured by the block system and its aids, the present fast mixed traffic could not possibly be handled on the existing lines.

Some exception may also be taken to the statement that the earlier types of block indicators were designed to represent the actual semaphores used for line signalling. Certainly the statement does not apply to the earliest examples of train-signalling instruments. Cooke and Wheatstone's indicator was a needle instrument, as were those of Bartholomew, Tyers and Bain; those used on the old Blackwall and the Birmingham and Gloucester railways, on the Midland Railway between Desford and Bagsworth, and through Thackley, Clay Cross and Duffield tunnels. Needle instruments were used also on the Great Western Railway as early as 1839 for a modified form of signalling, on the

Great Northern in 1851, and were adopted by Mr. Edwin Clark for the London and North-Western in 1853. It was not until about 1862 that Mr. Preece devised his apparatus, and contended for uniformity between the electrical and mechanical apparatus, although we believe that Mr. C. V. Walker had previously experimented with a semaphore arm attached to the axis of a needle instrument. It need hardly be said that the needle instrument now signals more miles of line in these islands, and those of the most important character, than any other type of instrument, and that on the whole, and leaving out of account the question of control of the operator, it fully deserves the confidence reposed in it.

On the question of the sufficiency of the ordinary block instrument the author is silent. A slight description of Preece's instrument, and a fuller description of Harper's, are given, but the absence of illustrations renders them of but little use to any but those already acquainted with the apparatus. Whilst their technical aspects are touched upon, no idea is given of their several merits as block indicators under all the conditions likely to arise. This is to be regretted, as, after all, details of construction are subordinate to effectiveness of operation.

In connection with the working of single lines, the author gives a very complete description of the Webb and Thompson train staff apparatus, which, together with the earlier apparatus of Tyers, has done so much to increase the capacity of single lines. To such an extent does this appear to be the case in Ireland, that the author says, "We shall probably see no new double lines of railway track in Ireland in our time." Accumulation of staffs due to unbalanced traffic on a single line is noted, and it is pointed out that staffs may be taken out in pairs and returned to the end which is deficient. It should, however, be noted that this is usually done by someone who is not connected with the control of the traffic, and that the operations involve unlocking of the apparatus. An adaptation of the train staff apparatus to the locking of swing bridges is given, and a condenser method of working telephone circuits on block wires is also described and illustrated. In the latter the block bell is used for calling attention to the telephone. Where communication is desired with an intermediate station, on a single line, without block or telegraph apparatus, a condenser and telephone set are connected as a leak on the train staff circuit. The saving effected by such methods of working will become more and more important, but as now available between adjacent cabins they are only useful for very local arrangements. For important main line work more extended communication is required, and this such methods are not capable of affording.

The author describes and illustrates an interesting and ingenious method of combining telephone and telegraph

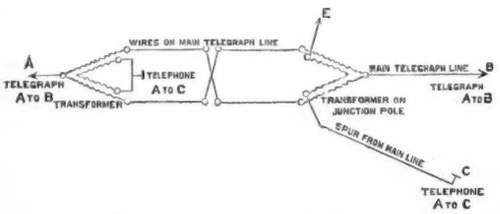

Diagram of Line Connections.

circuits which run on the same pole line, so as to obviate inductive disturbance of the former, without more wires than would be required for a single wire circuit for each. The arrangement is shown by the diagram. The two line wires are joined at each end through similar windings of two transformers, and the telegraph line is connected to the centres of the same windings at each end. The telephone sets are connected in the other windings of the respective transformers. If the telephone line wire is led off the line of poles carrying the telegraph wire, the transformer is placed at the junction pole and one end of the winding connected with the telephone is earthed there, the other end being connected to the continuation of the telephone line wire, and earthed through the telephone set as usual. The two line wires are in parallel so far as the telegraph currents are concerned, and the differential action of the transformer windings to these currents prevents disturbance to the telephone, which has a metallic circuit up to the transformer at the far end. Disturbance from other wires is prevented by crossing the line wires in the usual way. Obviously, the two line wires must have the same resistance in order to prevent disturbance of the telephone by the telegraph currents.

It would be interesting to know on what grounds the double-current sounder, with the relays "differentially wound," was selected for a circuit serving 13 stations. Perhaps, like so much railway work elsewhere, it simply "growed."

ELECTRIC WAVES AND THEIR EFFECT ON THE HUMAN BRAIN.

By A. FREDERICK COLLINS.

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The following account details some experiments I conducted last September for the purpose of establishing the nature of the relationship evidently existing between electric storms and persons afflicted by certain forms of nervous diseases.

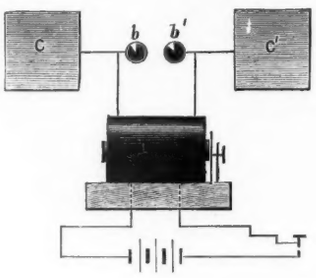


Fig. 1a.

Fig. 1b.

Fig. 3.

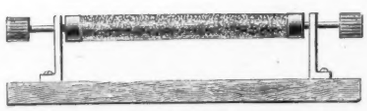


Fig. 2.

My first impressions were obtained upon observing the acute suffering of an old gentleman whenever a storm was in progress, with an accentuated type of *neurosis*, this being the generic name for a class of diseases having their origin in the nervous system. It was a matter of common knowledge that Mr. S—— could predict the approach of a storm several hours in advance with considerable accuracy, though the sky was clear at the time.

To trace the connection between the storms and this physiological effect, let us examine the data upon which the tests were based The experiments of Herr Heinrich Hertz, the discoverer of stationary electrical waves, are well known, since it is by these waves that wireless telegraphy has been made possible, but a brief review may assist in making clear the phenomenon under discussion.

Hertz, in 1888, in an attempt to verify the electromagnetic theory of light, found a simple, but most effective method of producing waves like light, except that the

frequency of oscillation producing them is measured, not by the hundred trillions per second, but slowed down to millions, or even thousands, per second, and that the length of wave emitted was measured by centimetres and metres instead of by the hundred-trillionths centimetre.

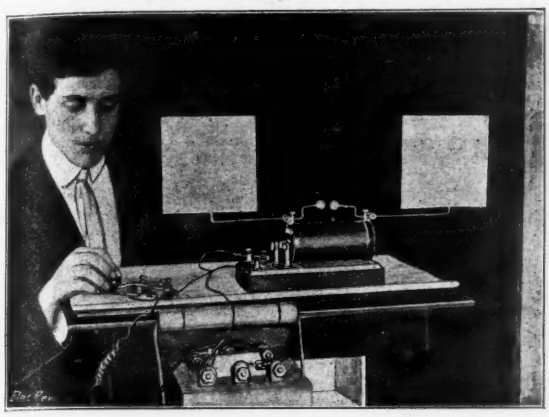


Fig. 4.—Radiator.

The apparatus Hertz employed was a Ruhmkorff coil, fig. 1A, with spark-gap *b b'* and capacity areas *c c'*, forming the oscillator system. To detect these waves, Hertz used a micrometer spark-gap detector shown in fig. 1B; when the circle of wire B was held at a distance from the coil A, and

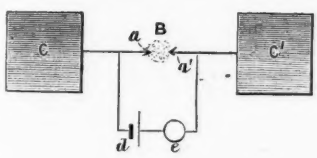


Fig. 5.

sparks caused to pass between *b b'*, minute sparks would pass simultaneously in the spark-gap of B. Now in this case the effect is not due to electricity passing through the air, but to *electric waves* propagated by the disruptive discharge, and these waves follow the laws of light in that they are capable of reflection, refraction, polarisation, and the final test for wave motion, interference. Hertz's detector was not very sensitive to the waves, and could be used only for short distances.

In 1884, prior to these tests, another phenomenon had been noted by Calzecchi Owsti on the cohesion of metal filings, but he did not determine the cause. Edouard Branly in 1891 observed that this action was due to electric waves, and made the first real coherer, shown in fig. 2, reduced to $\frac{1}{4}$th its original size. Another experiment made in 1891 by Larroque, a French scientist, bears so closely on the subject, that I append it likewise. He evolved the theory that the Hertzian or electric waves could be propagated over enormous distances through the middle and higher atmospheres, and constructed a detector consisting merely of a wire or "feeler" extending upward into the air and terminating in a zinc plate, fig. 3, the lower terminal ending in a small brass sphere *a*; a second sphere *a'* was adjusted forming a minute spark-gap, and this was earthed by means of a wire as shown. On the night of June 18th, when a terrific storm was raging over Corsica, sparks were observed to jump across the gap, though the sky was clear in France; these phenomena were repeatedly observed.

By the application of a Branly coherer to the Hertzian waves, Marconi has since demonstrated that the radiation can be propagated and detected over enormous distances.

In view of these facts, it seemed reasonable to believe that the electric waves emitted by lightning might affect existing pathological conditions, and it was to demonstrate if possible a change or an effect in the physiological tissues that these experiments were undertaken.

Accordingly, I procured from the *abattoir* the brain of a freshly-killed animal, and arranged an apparatus for sending out the electric waves or radiations as shown in fig. 1 in diagram, and in fig. 4 in half-tone. It was thought necessary to measure the resistance of the brain, and two needles connected to the testing set were imbedded in opposite hemispheres. The high resistance offered by the tissues to the passage of an electric current, especially considering its large cross-section, was surprising. A telephone receiver was introduced in place of the testing set, and two resonator plates connected as shown in the diagram fig. 5, *a a'* representing the coherer plugs, B the brain, *c c'* the resonator plates, *d* the dry cell and *e* the telephone. Waves were now sent out by the emitter at a distance of 3 metres, but there was no sound in the receiver; the results were *nil*. Had the waves appreciably cohered the brain cells, the telephone would have registered it. The result was disappointing. It then occurred to me that the resistance of the brain, like loose metal filings, was too great, and its sensitiveness therefore proportionately decreased.

The needles were inserted 1 mm. apart, and the key again pressed. There was a sharp click in the telephone receiver as though a carbon coherer had been employed instead of the brain cells. The key note had been struck that was to form the basis of the succeeding tests. Time after time the experiment was repeated, in all its possible variations, and

Fig. 6.—Listening to the Cohesion of a Living Cat's Brain.

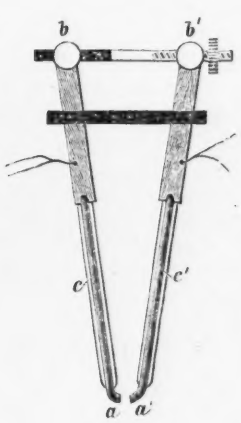


Fig. 7.

with many other brains from mammals, but with similar results. The tests proved that *cohesion of the brain cells in mammals takes place after death under the action of the waves.*

Having examined into the subject thus far, the question of such action on living brain cells followed as a natural sequence, and in order to carry out a second series of experiments, I consulted with Dr. Rotzell, lecturer on zoology and anthropology in the Hannehmann Medical College of Philadelphia, who lives near me in Marbuth. I communicated to him the preceding results obtained, and we decided

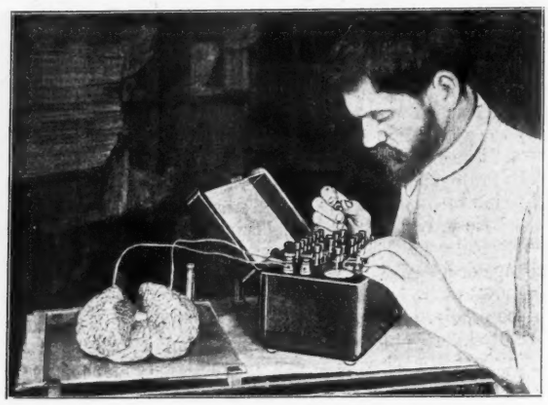


FIG. 8.—MEASURING THE ELECTRICAL RESISTANCE OF THE HUMAN BRAIN.

to make some control experiments. A large feline was subjected to the process of etherisation, and was soon in a deep hypnotic sleep. An incision was made at right angles to the frontal bone, and laying back the skin the cranium was exposed. Two holes were next drilled through the frontal with exceeding carefulness that the membrane might not be disturbed. These perforations were 1 mm. apart, and the needles of the receiving apparatus were inserted into the brain, as shown in fig. 6; an assistant operated the key of the emitting apparatus. The detector again consisted of the telephone receiver, selected for its great sensitiveness.

When the sparks passed between the oscillator balls of the emitter, the sounds of cohesion in the living brain were quite clear, though not as distinct as in the prior tests with the inert brains. This may have been due to the short circuiting of the current from the dry cell by the blood and other viscous matter. The cat was sub-conscious of the effect, and more ether was applied; the clicking continued, showing that the brain cells were self-righting or self-restoring, as it is called in the technique of wireless telegraphy. The doctor adjusted the receiver, and likewise noted the effects of cohesion; the assistant followed, but said the sounds were not very loud; this decrease may have been caused by the constantly impinging electric waves, rendering it less and less susceptible to the succeeding waves, or to the coherer needles moving the fraction of a millimetre, and producing too much or too little resistance.

After a number of similar tests, the table was moved to another part of the laboratory, where a better light could be obtained; at this moment the induction coil and battery circuit was accidentally closed, and the disrupting discharge sent forth a flood of invisible electric waves. The assistant was administering more ether, holding in his hand the paper cone containing the cotton, upon which the volatile fluid was poured, and forcing this over the nostrils, and to better accomplish the purpose, he held firmly the nape of the cat's neck with his left hand. He called our attention to the peculiar vibrations he felt at the base of the brain. The doctor and myself made subsequent examinations, with the same startling results. There was a rhythmic vibration of the muscles. When the emitter was stopped, the vibrations ceased; when in operation, the vibrations were in evidence. The effect was similar to that produced by a Du Bois Raymond apparatus, or the so-called "shocking coil," yet here the current was not broken by any mechanical means. One solution of the phenomenon was this: that the electric waves from the spark varied the resistance of the brain cells between the needle points, causing the current of electricity to vary between the limits of the maximum and minimum current strength, and these rapidly pulsating changes set up a reflex action in the muscles, just as a vibrator making and breaking the circuit would do, producing muscular contraction and reflection, or "shock," as it is popularly termed.

Note now, that if waves radiated by a 2 cm. spark would produce at a distance of 4 metres these results, what mighty effect would waves emitted by a flash of lightning at a distance of a mile have in a brain particularly susceptible to them? The tests were continued for an hour and 15 minutes, when the cat's fast ebbing life reached the vanishing point.

The tests proved that *cohesion of the brain cells of mammals in life takes place under the action of electric waves.*

While it may be assumed that there would be no difference in the action of the brain of man and animal to electric radiation, yet to make the tests complete it was necessary to experiment on a human brain. The difficulty in this is apparent, for a fresh brain must be employed; one prepared for the anatomist or having been treated with formalin or any preservative would not do, as the presence of extraneous chemicals would prevent any accurate knowledge being gained.

On a certain afternoon a fresh human brain came into my possession. Prior to this, Dr. L. H. Prince, an eminent pathologist of Philadelphia, suggested that special efforts be exerted in making the tests, and a coherer was designed for accuracy, ease of adjustment, and convenience of operation. Fig. 7 shows the details of construction; the points, *a a'*, are of platinum and are adjustable by means of the screws, *b b'*; the legs of the coherer, *c c'*, are of brass enclosed in glass tubing and sealed in at the junction where the platinum points formed right angles to them, this permitting the points to be sunk into the brain with only the surface of the ends in contact with it. Fig. 8 shows the apparatus used for measuring the resistance of the brain.

The brain is composed of two kinds of tissue, called the grey and white matter. Throughout the brain are distributed minute particles of grey matter called ganglia. The source of nervous force or vital principle of life lay in the ganglia. The nerve tracts which form the circuit for conducting the mental and physical impulses are composed of the white matter. The principal portions of the brain are

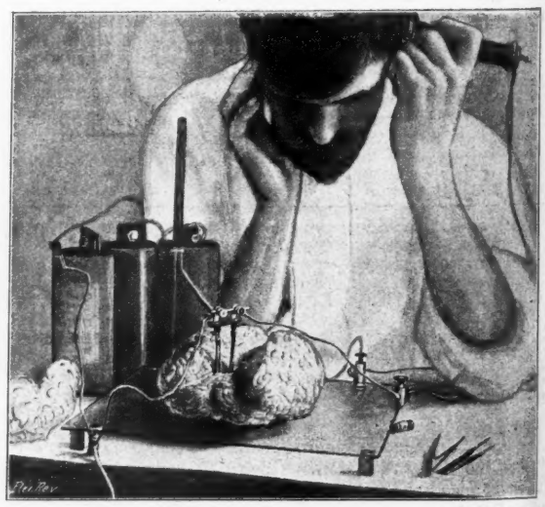


FIG 9.—LISTENING TO LIGHTNING DISCHARGES.

the medulla, the cerebrum, the cerebellum, and the pons Varolii. The resistance of the cross-section of the brain was measured, and found to be about 5,000 ohms, which, considering its dimensions, was high. The coherer was then adjusted to various portions of the brain to determine the most sensitive of the waves. First, the coherer was inserted into the grey matter of the cerebrum, and the result found

to coincide with the tests on the lower animals; slicing a portion from the upper part of the cerebrum, the core of white matter was next tried, but the sound of cohesion was much less distinct than with the grey matter. The medulla was less susceptible than the grey matter of the cerebrum. The grey and white matter of the pons was equal in sensibility to those portions of the cerebrum.

The different layers of the cerebellum were tested successively, but the rust-coloured granules were found to be the most sensitive to the electric waves. These tests required some dissection, but were made with the brain intact as far as possible. In the second series of tests I used an experimental coherer described in the *Scientific American* of June 15th, 1901. After removing the carbon, I inserted into the glass tube cross sections of the grey and white matter of the cerebrum, cerebellum, pons and medulla, as well as the rust-coloured granules, these taking the place of the silver filings in the coherer. Here, again, the rust-coloured granules proved the most sensitive to the waves; when examined under the microscope these granules consist of a nucleus of protoplasm. In conclusion, I intended to once more measure the resistivity of the brain; but after adjusting the needles and testing set, I was unable to balance the bridge arms; there was a divergence of several thousand ohms without apparent cause. A peal of thunder awakened me to the real cause: an electrical storm was approaching, and the theory I sought to verify with a small spark-coil was here produced in reality. For a period of 20 minutes the deflections of the galvanometer needle swung alternately to the + and then to the — end of the scale.

When the storm was at its height I substituted a telephone receiver for the testing set, and an instant later lightning struck the cupola of a house a quarter of a mile away; three sounds, like the cooling of metal when immersed in water, lead me to believe the lightning had struck thrice, which I afterwards ascertained to be so. (Fig. 9.) It was a weird experience, but it proved that *cohesion of the brain cells in man after death takes place under the action of electric waves.*

Now, finally, a case came under my notice where a little girl residing in Germantown, near Philadelphia, was thrown into convulsions as an electrical storm approached, and when, a few minutes later, lightning struck a house a quarter of a mile away, the child expired. The coroner returned the verdict that death resulted from shock and convulsions due to fright, but on the results of the foregoing experiments, I am of the opinion that death was not due to fright, but that the electric waves acted on the brain first, and the fatal physiological effects followed from cohesion of the brain cells. If the medulla was susceptible to the radiation to any appreciable extent, it was not difficult to understand how the physical expression took on the aspect of fear and how death could ensue, for in the medulla originate nerves controlling the facial muscles, and affecting directly the heart, lungs and stomach. With the deductions in nervous diseases, the experiments here given, and this last citation, it seems clear that *cohesion of the brain cells in man in life takes place under the action of the electric waves.*

THE ROYAL SOCIETY CONVERSAZIONE.

There was a large number of exhibits at the conversazione at Burlington House on the 14th inst., though none of them were of very striking novelty. However, it is too much to expect that every year will produce scientific discoveries of the first rank. We give as usual some account of those exhibits which appear to be of special interest to electrical engineers.

Two examples were shown of a new and very simple electricity meter, which is the joint invention of Mr. W. M. Mordey and Mr. G. C. Fricker, and is suitable for use with either direct or alternate current. It may be described as a clock in which the hairspring of the balance wheel is replaced by a magnetic field, produced by the current to be measured acting upon a soft iron needle on the balance wheel. The rate of oscillation of the balance wheel is thus proportional to the current passing through the coil which produces the magnetic field, and the counter actuated by the clockwork shows the integral of the ampere-hours. The construction of the meter will be readily understood from the illustrations.

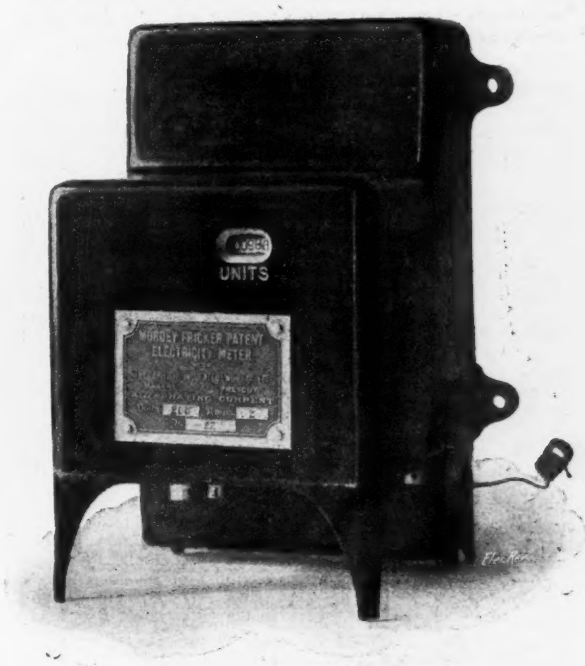


Fig. 1.

Fig. 1 shows the meter complete in its case. Fig. 2 is a front view with the cover removed. In fig. 3 one coil of the winding is removed to show the "armature." Fig. 4 gives curves from tests with both direct and alternating current.

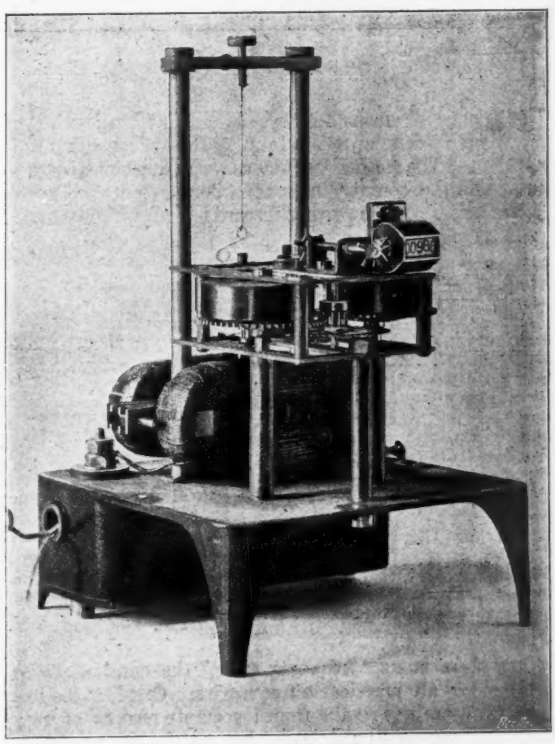


Fig. 2.

The illustrations are from photographs of a 10-light meter. The "armature" consists of a disc of slate on which a few pieces of iron wire or iron strip are fixed as in a compass card. This disc is mounted on the balance-wheel shaft, and is surrounded by a fixed coil of wire conveying the current

to be metered. The iron carried by the disc is magnetised more or less strongly by the current, a directive action being exerted in an opposite sense to that acting on a galvanometer needle, *i.e.*, tending to bring the iron needle to a central or axial position in the coil. The meter stops when no current is passing, and the disc comes to rest at one or other extreme of its arc of oscillation.

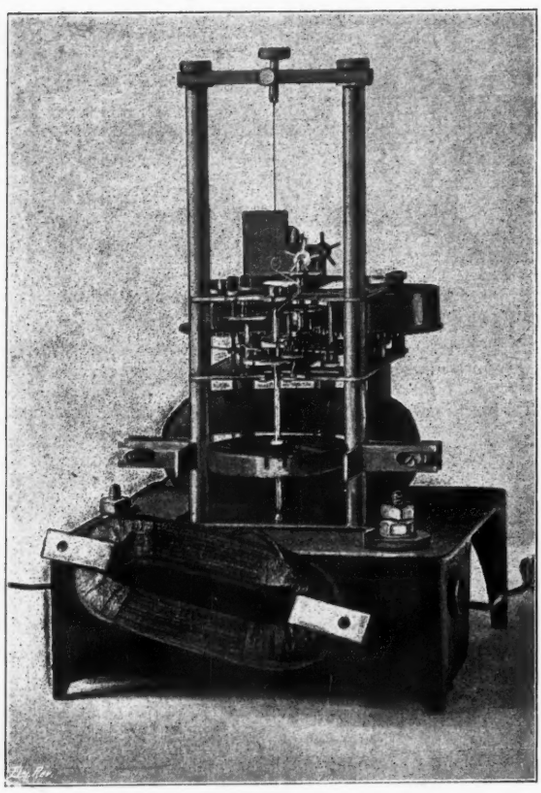


FIG. 3.

The balance wheel shaft is carried on a footstep jewel, the pressure on which is relieved by a torsionless silk fibre suspension. The meter is for use on constant-pressure circuits, and the counter indicates kilowatt-hours or Board of Trade units. An important feature is that, with alternate currents, there is no "frequency error," the constant being the same for all practicable frequencies. Considerable loss to supply authorities results from inaccurate records of very small and long-continued loads, but, as the curves, fig. 4, show, the Mordey-Fricker meter gives very accurate records with the smallest loads met with in practice, such as one 5-C.P. or one 8-C.P. lamp. The clockwork requires to be wound up only once in three months, so that it can be conveniently done by the meter inspector, and no self-winding gear is necessary. The meter can also be adapted for use with motors.

Dr. Muirhead exhibited a cable relay in operation. It was placed between two circuits of artificial cable, each representing about 1,250 miles of actual cable, with an automatic curb transmitter at the sending or signalling end of one circuit and a siphon recorder at the receiving end of the other circuit. In the cable relay the local contacts were made between a metallic arm, which is connected by fibres to the signal coil, and a vibrating body, whose metallic surface is divided by thin insulating partitions into three sections to constitute the two terminals of a local line or retransmitting battery with a zero section between. The signals given by the siphon recorder were very distinct, and in every case came back to the zero line.

Mr. Pidgeon showed his latest form of influence machine in operation. This machine is made to resist hard usage, and is suitable for military field work with the X-rays. The machine is of the type with oppositely rotating discs combined with fixed inductors, which has already been constructed in various forms by Mr. Pidgeon. This latest machine is made more compact by placing all the rotating discs as close together as is desirable, and leakage is greatly reduced by completely enclosing the carriers in the discs, which are made of a new insulating material—"volenite." The coating of wax and resin used in his previous machines is dispensed with. Except in the case of the terminal discs, contact is made with the carriers at the periphery of the disc. The discs are driven by toothed gearing.

Prof. Fleming gave a demonstration of Zickler's system of wireless telegraphy by ultra-violet light.* The experiments exhibited showed the action of the ultra-violet light emitted from the edge of the coating of a Leyden jar upon the spark of the induction coil which charged it. The jar was arranged between two spark gaps in parallel, one longer than the other, and both connected to the terminals of an induction coil. The jar being placed nearest to the shorter gap, the spark always took place at this gap, but when the ultra-violet light was cut off by interposing a plate of mica the spark immediately appeared at the other gap. This latter gap was then quenched by illuminating the shorter gap by a naked arc light. These effects, we believe, have been demonstrated at a distance of a mile from the source of ultra-violet light.

Mr. Mackenzie Davidson exhibited stereoscopic X-ray transparencies in a Wheatstone stereoscope. In the photograph of a skull the thickness of the bone could be distinctly seen. There were also X-ray photographs of a bullet fired from a revolver. Mr. Mackenzie Davidson also gave demonstrations during the evening of the development in daylight of light impressions on Röntgenised photographic plates. He failed, however, to mention that the discovery of this remarkable phenomenon was due to Nipher.†

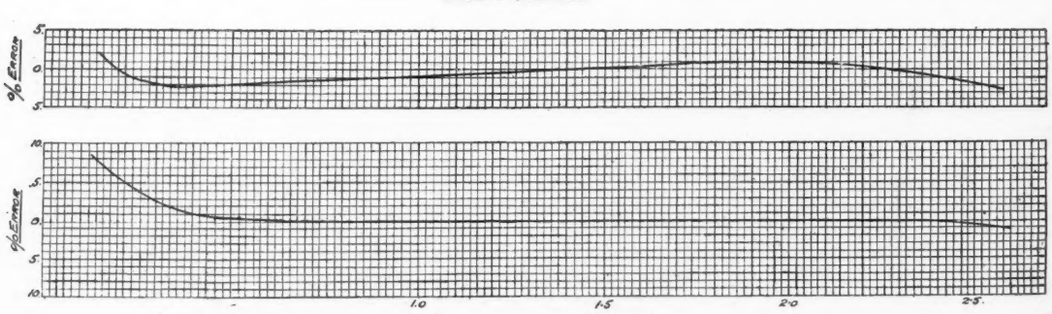


FIG. 4.—TESTS OF MORDEY-FRICKER METER.

Dr. Dawson Turner showed that the ultra-violet radiation of a condenser spark between iron electrodes would discharge both negatively and positively charged bodies.

Whipple's temperature indicator, exhibited by the Cambridge Scientific Instrument Company, is intended for use with a platinum resistance thermometer. The bridge wire is wound on a cylinder in the form of a screw, and the sliding contact is moved until the resistance of the thermo-

* ELECTRICAL REVIEW, March 31st, 1899, p. 515.
† ELEC. REV., August 10th, 1900, p. 208.

meter is balanced. The temperature is read from a scale graduated to give the temperature on a gas scale, and not on the platinum scale, as in Callendar and Griffiths's temperature indicator.

Prof. S. P. Thompson exhibited some rare editions of the works of Dr. William Gilbert, of Colchester, the founder of the Sciences of Electricity and Magnetism, among which were the first folio Latin edition of *De Magnete*, London, 1600, the second Latin (quarto) edition of *De Magnete*, Stettin, 1628, and the third Latin (quarto) edition of *De Magnete*, Stettin, 1633.

Mr. C. E. Stromeyer gave an experimental illustration of a peculiar cause of steam pipe explosions, which may be of some value in enabling engineers to avoid such disasters. The apparatus consisted of a glass L tube, which represented a branch steam pipe. The lower limb was closed by an india-rubber stopper representing the stop valve on an unused boiler. The upper limb was connected to a flask in which water was being boiled and represented the main pipe full of steam. The L pipe collected condensed water, which when drained away by the attendant led to water hammer blows and to explosions.

Mr. Cossor exhibited a fine specimen of a Braun tube. This tube, as has been often pointed out in the ELECTRICAL REVIEW, is an invaluable means of indicating rapid variations of current or of the magnetic field. The indicator being a pencil of cathode rays with practically no inertia, the response to changes of a magnetic field acting on the pencil of rays is instantaneous.

Prof. Wilson showed the results of experiments on the distribution of electric currents induced in a solid iron cylinder when rotated in a magnetic field. By passing insulated conductors through longitudinal holes in the cylinder the change of magnetism at different depths in the cylinder was measured. Diagrams on the wall showed the effect of variation of the magnetising force. For a given speed of rotation, with small force, the centre of the cylinder experiences considerable change of induction as compared with the surface, accompanied by comparatively small phase displacement. For intermediate force, the change of induction at the centre becomes relatively very much smaller, accompanied by a large phase displacement. For large magnetising force, the change of induction at the centre is again important, and the phase displacement again small. The effect of variation of speed of rotation was shown.

PARLIAMENTARY.

South Shields, Sunderland and District Tramway Bill.

A Select Committee of the House of Lords, presided over by the Duke of Northumberland, on 7th, 8th and 9th inst., had under consideration the South Shields, Sunderland and District Tramway Bill. Mr. Balfour Browne, K.C., Mr. Freeman, K.C., Mr. E. H. Lloyd, and Mr. C. C. Hutchinson appeared for the promoters, and there were a number of petitioners against the Bill, including the South Shields Corporation, who were represented by Mr. L. Coward, K.C., and Mr. Hans Hamilton.

Mr. Browne, in opening the case for the promoters, said the Bill authorised the British Electric Traction Company to construct tramways between South Shields and Sunderland. The proposed lines would start in the northern part of South Shields, and would pass through Harton to Whitburn. There a branch line would go to the south of Sunderland and the main line would also go on to Sunderland. In either case the lines would join the authorised tramways of the Sunderland Corporation. The proposed lines were 8 miles 1 furlong in length, would be constructed on a 4 ft. 8½ in. gauge, and would be worked on the electric overhead trolley system. Of all the local authorities affected, only South Shields opposed. The first idea was to deal with the tramways as a light railway scheme, but the Light Railway Commissioners thought the scheme so important that it should receive the sanction of Parliament. With regard to South Shields, that body seven years ago obtained power to construct tramways on a 3 ft. 6 in. gauge, but nothing had been done, and consequently the promoters asked for authority to construct a line over Westoe Lane, which was in the centre of South Shields, and was a road over which the Corporation were authorised to construct a tramway In 1901 the Corporation proposed to introduce a Bill giving them power to use the 4 ft. 8½ in. gauge, and asking for powers to work the tramways themselves, but this the ratepayers refused to sanction, and consequently the Corporation had now no power to work tramways themselves.

Mr. Coulson, the clerk to the Rural District Council of South Shields, stated that in 1900 the Council were approached by two companies who wished to construct tramways in the district, and they decided to support the British Electric Traction Company in their application before the Light Railway Commissioners. As the Commissioners considered that there would be competition with a railway they decided that the scheme ought to have the approval of Parliament. Witness proceeded to deal with the benefits which would accrue to the district from the construction of the tramways, and mentioned that the Council, by an arrangement with the company, could obtain current for electric lighting. He believed an agreement had been come to by which there would be a junction with the Sunderland tramways. Similar evidence was given by other representatives of local authorities in the district concerned.

Several witnesses were called representing the South Shields Property Owners' and Ratepayers' Association, which Association strongly objected to municipal trading, and therefore objected to the South Shields Corporation going in for tramways.

On the resumption of the sitting, Alderman Redhead, of South Shields, said they wanted tramways as cheaply and as quickly as possible, and he considered the company was more likely to give them that than the Corporation. Other evidence of a similar character was given.

Mr. Stephen Sellon, engineer to the British Electric Traction Company, said the total length of the main line of the proposed tramway was 5 miles 2 furlongs, and the spur line from Cleadon *viâ* Whitburn and Fulwell was 2 miles 6 furlongs in length. The Parliamentary estimate was £98,800. In his judgment that was amply sufficient. The gauge would be 4 ft. 8½ in. It was intended to work the tramways on the system which had been so successful all over the country—viz., the overhead electrical system. In preparing the scheme, whilst taking care to serve the needs of South Shields, they had paid particular attention to providing intercommunication with the adjoining districts. The North-Eastern Railway Company had alleged that the tramways would take from them traffic of the annual value of £25,000. He had taken some trouble to ascertain what would be the traffic affected by the tramway. The traffic for one week—April 2nd to 8th—this year from South Shields and Sunderland and intermediate stations was found to be £242. He knew instances where tramways ran absolutely parallel to the railway lines, but in spite of that, Parliament sanctioned them. In cross-examination by Mr. Coward, Witness said he knew of a case where a company had got powers without the consent of the Corporation.

Mr. Coward addressed the Committee on behalf of the South Shields Corporation, and said that in 1882 the Corporation constructed some tramways, but, unfortunately, such was the narrowness of the streets, that those tramways had to be constructed on a gauge of only 3 ft. 6 in. Therefore, what happened under this or any other Bill was that, unless and until an alteration of gauge had been effected, it would be difficult to get a continuous system of tramways. The lease of the existing tramways granted to the South Shields Tramway Company expires on February 1st, 1906. In 1896 the Corporation went to Parliament for powers to construct other lines, and then again it was deemed desirable that they should be constructed on a gauge of 3 ft. 6 in. The period for their completion expires in July, 1903. The Corporation had to apply to Parliament for compulsory powers to take land, which they thought they had got. That afforded some explanation of any suggestion of delay. The Corporation were desirous of constructing their trams, and being in a position to work them.

Evidence have been called in support of the South Shields case, the Committee, after consulting in private, announced that they had found the preamble not proved.

Lord Ribblesdale's Tube Committee.

On resuming on 9th inst., this Committee proceeded with the consideration of the City and Crystal Palace Railway Bill.

Mr. S. Sellon, the engineer and electrical adviser to the British Electric Traction Company, stated that his company would be willing to give substantial assistance towards the carrying out of the undertaking; and Mr. F. Schenck, on behalf of the Crystal Palace Company, said he would be prepared to find capital to the extent of £1,000,000 if the Bill passed. He considered it would be a very great advantage to the Palace to have the proposed railway constructed.

After deliberating for a short time, the Chairman said the Committee had decided that the preamble of the Bill must be rejected, and therefore there was nothing to be gained by proceeding further with the case.

Mr. Moon, K.C., then opened the case on behalf of the promoters of the Great Northern and City Railway. He said the Bill simply sought for powers to enable an extension to be made of a line which was rapidly approaching completion. The line commenced underneath the station of the Great Northern Railway at Finsbury Park, and ran down to the City as far as Finsbury Pavement. There would be an interchange station with the Great Northern Railway at Finsbury Park, and it was hoped that the line would be opened in the course of a year. Under the present Bill the company wished to obtain powers to continue the railway on from Finsbury Pavement to the Bank. They also wished to erect a generating station at Shoreditch, to construct a station for passengers at Highbury and to enlarge the station at Finsbury Pavement. All those works were necessary for the better working of the railway, and the extension to the Bank would be a great convenience to the travelling public.

The chairman of the company, Sir Charles Scotter, and Sir Henry Oakley, a director of the Great Northern Railway, having given evidence in favour of the Bill, local evidence was tendered by Mr.

G. C. T. Bartley, M.P., and Mr. Claude Hay, M.P., to the effect that the proposed extension would be a great boon to the public. The Committee then adjourned.

On the Committee resuming on 12th inst., two members were absent through indisposition—Lord Clanwilliam and Lord Aberdare. Some discussion took place between the various counsel interested, and it was agreed by the parties to accept the decision of the four remaining members, and the consideration of the Great Northern and City Bill was continued.

Sir DOUGLAS FOX explained that, as regarded tunnel work, the line would not approach nearer to the Bank of England than the southern end of Moorgate Street. There would be a subway for passengers coming up to the railings of the Bank, but the nearest shaft would be 30 ft. away. Five shafts would be constructed between the corner of the Bank and the end of Moorgate Street for the purpose of getting lifts down into the tunnel. With the shield process of driving there was practically no risk to buildings during the construction of the line.

Mr. RAM, K.C., for the Bank of England, addressed the Committee, and very strongly urged the necessity of giving the Bank the protection of the Bank of England clause if the Bill was allowed to proceed. He pointed out that the model clause suggested by the promoters only gave protection for a period of two years, whereas the Bank of England clause gave protection for all time.

The CHAIRMAN said that, having regard to what the Bank of England meant to the City of London, and to the credit of the world, he thought it likely the Committee would impose a special clause for its protection. He could promise that the question would have full consideration when the proper time came. As to the model clause which had been referred to, it was not his intention that the appeal to a special tribunal should extend to those who had their right under the Land and Clauses Act. The clause to be submitted by the promoters might prove a basis of agreement.

Mr. MOON, K.C., on behalf of the promoters, said they were willing to consent to a clause giving protection for a term of two years, but if, as a result of the deliberations of Lord Windsor's Committee, a longer period should be agreed upon, then he would promise that the Bill should be so amended before it reached the other House.

Mr. LITTLER, K.C., having addressed the Committee on behalf of the Corporation of the City, who, he said, viewed the project with suspicion on the ground that the promoters had some ulterior motive, Mr. A. C. MORTON, C.C., a member of the Streets Committee of the Corporation, gave evidence in opposition to the Bill.

After deliberation, the CHAIRMAN announced that the Committee considered the preamble of the Bill proved, and intimated that they would require a special clause to be inserted for the protection of property owners; and also a special clause for the Bank of England. Before deciding upon the exact clause, he would consult with Lord Windsor and the Chairman of Committees.

Mr. BAGGALLAY, K.C., then briefly opened the case of the North West London Railway Bill. He explained that the only object of the Bill was to obtain an extension of time for three years for the construction of a tube line, which was authorised in 1899, from Marble Arch to Cricklewood under the Edgware Road. Power was also asked to enable the tubes to be constructed 13 ft. in diameter, as against 12 ft. 6 in. as originally proposed.

After hearing evidence in favour of the Bill, the Committee declared the preamble proved. The Committee adjourned.

The Committee, on resuming its sitting on 13th inst., considered a number of clauses proposed by Mr. Talbot for the L.C.C. for insertion in the North-West London Railway Bill, and provision was asked to be inserted for reducing the workmen's fares to 1d. single and 2d. return, and slightly extending the time within which the workmen's tickets would be available.

Mr. BAGGALLAY, K.C., raised objection to the clause, stating that the matter having been threshed out in 1899 it was not necessary to alter the decision then arrived at. The amendment was rejected.

Mr. BALFOUR BROWNE, K.C., then gave evidence on behalf of the Great Northern and Strand Bill, which he said was for extending the time for authorised construction of a tube railway from Finsbury Park to the Strand. The preamble was declared proved.

The clauses of the Great Northern and City Railway Bill were next considered. The CHAIRMAN said the Committee thought that what was known as the Bank of England clause should be inserted with a distinct understanding that it was for the protection of the Bank of England as a special building.

Mr. MOON, K.C., put before the Committee the terms of a clause the promoters were willing to insert in the Bill for the protection of persons whose property might be damaged by the working of the tube railway. It provided that if before the expiration of two years from the opening of the railway any damage should be incurred to property, the owner would have the right of compensation, in addition to any remedy given under the existing law.

The CHAIRMAN submitted a clause which he thought was a model one that he should like inserted in all tube railway Bills. It provided that, if at any time within two years after the opening of the railway an owner or lessee of land or buildings complained of damage or annoyance from the working of the line for which he could not lay claim under the Land Clauses Act, that such complaint should be placed before an arbitrator appointed by the Board of Trade. If necessary, the arbitrator could be assisted by two engineers, and have power to award compensation.

The Committee, after consultation, agreed to let the matter respecting the clause stand over till after Whitsuntide, and after consultation with Lord Windsor's Committee. The Committee adjourned.

The Committee finished the consideration of the various Bills before them at their meeting on Wednesday of last week. Discussing the clauses of the Great Northern and Strand Railway, on the suggestion of the London County Council, clauses were inserted providing for the sale of workmen's tickets in batches to employers, and prohibiting any increase of fares on public holidays.

Mr. PAGE, K.C., briefly submitted the Bill of the Baker Street and Waterloo Railway to the Committee. He pointed out that it was simply to obtain an extension of time for the purchase of land and construction of works. The line was authorised in 1893, and in 1897 arrangements were made with the London and Globe Finance Company to finance the line, and in 1900 a second agreement was made with the company to carry out an authorised extension. The work was begun after the agreement of 1897, but the failure of the London and Globe Company last year had placed them in difficulties, and therefore they asked the Committee to grant an extension of time.

Mr. PERKS, M.P., stated that 60 per cent. of the tunnelling had been completed, and the stations were completed, or in course of construction. The District Company would submit a revised scale of fares next year and ask Parliamentary sanction for them.

The preamble of the Bill was declared proved and the clauses were adjusted; subject to the insertion of a model clause which is to be inserted for the protection of property owners against injury, and which clause is to be drawn up in consultation with Lord Windsor's Committee.

LONDON COUNTY COUNCIL TRAMWAYS.

MR. HOBHOUSE'S Select Committee of the House of Commons resumed consideration of the L.C.C. Bill on 9th inst., when various local witnesses were called in favour of the new tramways proposed under the Bill.

On proceeding to hear the opposition, some discussion arose between counsel and the Committee as to whether they would be justified in entering upon the general case, in dealing with the petitions of frontagers on the Victoria Embankment. The CHAIRMAN said the Committee could not allow counsel to enter into the general case—they must confine their objections to specific matters where they alleged they would be injuriously affected by a tramway.

Lord R. CECIL, K.C., said that under those circumstances he must respectfully retire from the Committee, as he wished to enter upon the general case.

Evidence was then tendered on behalf of the District Railway Company in opposition to the Embankment tramways.

Mr. J. W. WHITTAM, accountant to the District Railway, said he was confident that the tramways would not get enough traffic to make them remunerative.

Major ISAACS, the deputy chairman of the District Railway, said that in his opinion an electric tramway along the Thames Embankment would spoil what had hitherto been one of London's finest thoroughfares. It would be wholly out of harmony with the surroundings, and would impede the quick traffic which now used the Embankment to get from the City to the West End or *vice versâ*. His company had had great difficulties to contend against, and he thought they ought to be protected from this sort of competition. With the introduction of electricity on their railway the turn of the tide seemed approaching, and he had little or no doubt that the company had a prosperous future before it. It would be manifestly unfair to the original shareholders that just when they were hoping for a return on their capital it should be prevented by this tramway competition. It was a matter of common knowledge that the Central London Railway had very prejudicially affected the company's earnings. As a matter of fact, their revenue had fallen by £15,000 a week from what it was a few years ago, and the board attributed the falling away of the traffic to the tube railways on the northern side, and the tramway on the western side of their system. The Committee then adjourned.

On 13th inst. the hearing of the Bill was continued, and Mr. ERSKINE POLLOCK having replied for the County Council, the Committee conferred in private.

On the proceedings being resumed, the CHAIRMAN announced that the Committee had unanimously come to the conclusion to recommend that the tramway be authorised on the Thames Embankment from Westminster to Waterloo Bridge, so that it could form a junction with the line authorised by the L.C.C. Subways and Tramways Bill, but there would be a clause for the protection of the District Railway.

Mr. COWARD, K.C., afterwards addressed the Committee in opposition to the proposed tramway from Camberwell Green to East Dulwich and Lordship Lane, and a number of frontagers gave evidence as to the probable damage which would be caused to property. The Committee again adjourned.

On Wednesday last week the hearing was resumed, and Mr. J. HETHERINGTON, J.P., giving evidence on behalf of the Camberwell Council, contended that the proposed tramway between Camberwell and Dulwich was unnecessary, as a good train service was supplied by the two railway companies, besides facilities given from Camberwell Green by other tramcars and 'buses. If heavy electric cars were to constantly run along the embankment at Champion Park, he feared it would give way.

Mr. CLODE appeared on behalf of the S.E. & C. Railway, and said that it had been ascertained since the Bill had been deposited, that the proposal was not for the construction of a line of about 2¼ miles, that would not compete with the railway, but a portion of a scheme to run a line to the Crystal Palace.

The Committee having consulted in private, the CHAIRMAN announced that they had decided to approve of the tramway proposals. A clause would be required in the Bill in order that a more convenient terminus might be provided for the Putney line in the lower Richmond Road.

The Committee then considered the proposal of the L.C.C. to widen the Hampstead Road at the junction with Tottenham Court Road.

On Thursday last week the Committee considered the clauses for the protection of the District Railway, which provided that the construction of the line along the Embankment should be carried out with as little interference as possible to the railway, and upon plans and sections to be submitted within 21 days' notice to the engineer of the company and approved by him. In the event of injury to the railway structure by the tramway, the railway could recover the cost of repairs from the Council, or in default of agreement between the parties, the cost to be settled by arbitration; and if in the opinion of the railway company any strengthening of the structure of their line was necessary, 28 days' notice must be given.

The CHAIRMAN said the Committee had come to the conclusion that the tramway should not be constructed on the overhead system. An enactment to that effect was necessary, and would perhaps apply to all the tramways.

Mr. ERSKINE POLLOCK, K.C., pointed out that under the Electric Powers Act it was to be the conduit system unless the local authority assented to the overhead system. He admitted that the Embankment was an exceptional case, for there the Council was the road authority.

The Committee finally decided that the prohibition of overhead wires should include the lines along the Embankment and at Denmark Hill and Putney. The Bill as amended was then ordered to be reported to the House.

NORTH METROPOLITAN ELECTRIC POWER SUPPLY BILL.

Mr. FISON has reported from the Committee on Group J of Private Bills: That in the case of the North Metropolitan Electric Power Supply Bill they had agreed to the following report:—"That a report from the Local Government Board relative to Clauses 6 and 10 of the Bill had been referred to and considered by the Committee. The Committee had struck out Clause 6 of the Bill, and with regard to Clause 10 the recommendation contained in the report had been adopted. That there are no other circumstances of which, in the opinion of the Committee, it is desirable that the House should be informed."

Mr. FISON further reported from the Committee: "That they had examined the allegations contained in the preamble of the Bill, and amended the same by striking out so much thereof as related to the proposed extension of the company's limits of supply to include the urban district of Willesden, and had otherwise amended the same so as to make it consistent with the provisions of the Bill as passed by the Committee, and found the same as amended to be true, and had gone through the Bill and made amendments thereunto."

LORD WINDSOR'S TUBE COMMITTEE.

AT the resumed sitting of this Committee on Tuesday, 6th inst., Sir HENRY OAKLEY was recalled, and in cross-examination said that his board was advised that there would be no difficulty in raising the capital required for the extensions at par. He did not think that the capital could be separated from the old capital. The estimated expenditure on the extensions was £4,151,000. The works and lands would absorb nearly £3,000,000, and another £900,000 would be required for the construction of lifts and rolling stock. The cost of construction came out at £470,000 a mile, compared with £579,000 for the existing line, but the difference was accounted for by the fact that the construction could be looked after more closely and more was known about it. The proposed line, it was true, was nowhere more than 6 furlongs distant from the existing line, but even in spite of the "tube," the traffic along Piccadilly was much greater than by the Oxford Street route. The figures for the Oxford Street route were: at Marble Arch, 10,974 vehicles and 21,080 pedestrians in a day of 12 hours from 8 a.m. to 8 p.m.; at Oxford Circus the figures were 12,331 and 54,100; and at Holborn Bars 14,301 and 59,455. On the Piccadilly route the figures were, at Knightsbridge 18,874 and 37,036; at Piccadilly Circus 12,501 and 52,930; and in the Strand 11,927 and 56,927. That proved the larger stream of traffic by the more southern route. The scheme proposed by the company had been carefully planned to avoid congestion in the City, and was so far successful as to obtain the approval of the Corporation.

Sir BENJAMIN BAKER, engineer to the railway, said he had also been engineer to the pioneer tube line, the City and South London Railway. The idea was purely a British one, and had been carried into effect by British capital, and it had only been when the shares went to a premium, and the capabilities of the system were proved, that the Americans sought to come in. Witness here proceeded to give a description of the new extension, and the facilities afforded by its interchanges at the various points with other railways.

Cross-examined, WITNESS said the construction of the new line in the City would be in clay; as a rule the subsidences had occurred along old water courses, and they were mostly due, not to the tubes, but to the shafts and subways at the stations. As to the Bank of England, its clause in the original Central London Act could be given to it again by this Bill, but he thought the promoters would rather have it put on them by the Committee, than grant it of their own accord. There was no special reason for giving the Bank of England clause to St. George's Hospital, which would of necessity apply to every house in Prince's Gate. The Albert Hall, however, being a special building, would require special treatment. The tubes might pass within 16 ft. of it, within the limits of deviation, but with respect to giving it the Bank of England clause, he was in the same position as that he had stated with regard to the Bank of England itself. The Committee adjourned.

On Wednesday, 7th inst., the consideration of the proposals for the extension of the Central London Railway, and other schemes involving the construction of tubes along Piccadilly, was resumed.

Sir B. BAKER was recalled and, further cross-examined, stated that in the original prospectus of the company it was stated that the line was to be worked as a local line, and would seek no extension.

The CHAIRMAN, having consulted with the members of the Committee, said: Before you go on, it would be convenient that the Committee should state that having been considering in conjunction with Lord Ribblesdale's Committee and the Chairman of the Committees the question of a compensation clause, they have arrived at this conclusion, that they are inclined to consider the advisability of inserting a general clause giving a limited period, possibly two years after the opening of the railways, during which all questions of damage arising from construction or working should be referred to a special tribunal or to an arbitrator. If the promoters agree to such a clause, the proceedings may be materially shortened, but the Committee reserves to itself the right of imposing on the promoters such special clauses as in their opinion may be necessary for the protection of particular buildings. I would point out that the Committee leave the actual terms of such a clause open, they say possibly two years, but that is a question on which naturally something might be said. The Committee have not in their minds any intention of referring these matters to a court of law, but they suggest a special tribunal or arbitrator. Lastly, I would suggest that counsel should consider this, and if they can bring up a clause on which promoters and opponents can agree, we shall be glad to consider it.

Mr. PEMBER, K.C., thought that would not be difficult; once the principle was agreed upon, the agents could draw the clause. He did not see why some special clause of the kind should not also be agreed upon for special buildings, and then the only question would be, which special buildings should be scheduled.

Viscount KNUTSFORD said if this could be done it would clearly shorten the proceedings, because then there would be no necessity to hear the evidence of owners of property.

Replying to the CHAIRMAN, Sir B. BAKER gave it as his opinion that it would be detrimental to make it a sort of standing order that tubes must be 13½ ft. in diameter, because he thought it would prevent the construction of certain railways altogether. But, putting aside entirely the question of expense, he did not believe any material advantage would be obtained by having the larger-sized tubes either on the score of public safety or on that of convenience of working.

Mr. PARSHALL, electrical adviser to the railway, said there had been no electrical failure on the line since it started. Plans had recently been approved by the Board of Trade for new rolling stock which was fireproof, and had a motor to the front and end cars, thus doing away with the locomotives, which were the great cause of vibration. The new expenditure on the power house would be £83,000; on steam plant, £115,000; on electrical generation and distribution, £150,000; on passenger stations and 60 lifts, £187,500; and on 28 new trains, £258,000. It was proposed to enlarge the generating station at Shepherd's Bush to enable them to run a minute and a half service with a good margin. The total estimate for electrical equipment and rolling stock was £798,000. It was proposed to run at a speed of 16 miles an hour. The trains would have a motor car at each end and two such cars in the centre.

Mr. VIGERS, surveyor and valuer, said he had made an estimate for the land and easements required for the extension of the Central London Railway, and it was £873,000. Two principal cases of subsidence had occurred on the existing line at Bond Street and Lancaster Gate, and they were attributed to the station shafts. He believed the tubes were in the clay.

Mr. F. Harrison, general manager of the London & North-Western Railway, Mr. C. G. Mott, chairman, and Mr. Jenkins, general manager of the City & South London Railway, Mr. Gooday, general manager of the Great Eastern Railway, and Mr. Vincent Hill, general manager of the S.E. & C. Railways, also gave evidence in favour of the scheme, which concluded the case for the promoters.

The opposition of the Great Eastern Railway to the projected North-East London, and the City & North-East Suburban Railways was then proceeded with, when

Lord CLAUD HAMILTON, chairman of the G.E.R., said that, in order to meet the increased traffic to and from the suburban districts served by that railway, they had extended and improved their service. New carriages had been built with larger seating capacity, and that measure had to a large extent met the demands of the traffic, especially in respect of the grievance of overcrowding. When all the carriages had been widened, they would be able to carry 76,000 more passengers daily into London than they did at present. They were also building new engines to draw from 17 to 20 coaches at a higher speed than was run now. Consideration was also being given to the question of electrifying their local lines. Cross-examined, the witness said that at a meeting of the company in 1899 he stated that the directors were painfully aware that the suburban traffic had grown so quickly that they had been unable to overtake it, and that they could not increase the

number of trains during the busy part of the day. The Committee adjourned.

On 9th inst. this Committee again sat to further consider the Brompton and Piccadilly Circus Railway Bill.

Colonel Yorke, chief inspector of railways under the Board of Trade, in again giving evidence, said it had been suggested that the companies should be compelled to deposit with the Board of Trade or with some other public authority plans showing exactly the line along which the railway had been constructed, and that the plans should be open for inspection in order that the property owners and others interested could have an opportunity of ascertaining where the line was situated. No statutory obligations were placed on the railway companies to deposit plans with the Board of Trade, though certain plans were deposited under an arrangement between the engineers of the company and the Department. It was therefore suggested by the Department that there should be some such clause as was contained in the Waterworks Clauses Act and the Gas Clauses Act, inserted in these Bills, providing that plans should be kept at the office of the undertakers, and should be open to all persons interested at all times.

Mr. Pember, K.C., on behalf of St. George's Hospital and also the L.C.C., said he would agree to that suggestion.

Replying to the Chairman, Colonel Yorke said the attention of the Board of Trade had been drawn to the fact that on the Brompton and Piccadilly Circus line there was a curve of 3½ chains' radius. He regarded such a sharp curve with considerable misgiving, and felt it his duty to take exception to it. Even though the radius were altered to four and a half chains he should think it obligatory upon the Board of Trade to put a restriction on the speed of the train when passing the curve, which would probably have an effect upon the train service running over the whole of the circuit. The tendency of the motor man, he thought, would be to approach the curve at a higher rate of speed than was desired. He thought a five-chain curve was the smallest curve that was advisable, and if a three-and-a-half-chain curve was authorised, it should be incumbent to advise the Board of Trade to limit the speed of the trains to 12 miles an hour, and with a curve of four and a half chains to 13 or 14 miles an hour. In the case of the reverse curves there should be a length of straight line interposed between the two. With respect to the dimensions of the tube, the Board of Trade would insist on the larger tunnels only in those lines which were now taking Parliamentary powers for the first time. They were desirous not to put any additional burdens on the companies which had already received Parliamentary powers for the construction of railways, but they desired to see that the relative proportions of the rolling stock and the tube were such as to give a sufficient clearance. He thought that was a matter which could be discussed under the clause submitted by him on the first day. He believed a maximum sized tube might be fixed up to which the companies might work, and beyond which they might not go.

Cross-examined, Witness said the shape of the tunnel could be left to the Board of Trade. Hitherto it had been assumed that tubes must be invariably circular in section, but it had occurred to him that there would be conveniences and advantages if they were constructed similarly to those of ordinary railway tunnels. There was nothing in the Bills to render it absolutely obligatory on the companies to make a circular tube. He was not prepared to state how close together the tubes should be constructed.

Mr. Littler, K.C., said the company were prepared to place themselves unreservedly in the hands of the Board of Trade as to the construction and method of working of the line.

Mr. J. F. Gooday, general manager of the Great Eastern Railway, then gave evidence in opposition to the proposed North-East London and City and North-East Suburban Railways. Cross-examined by Mr. Pember, K.C., Witness said he thought the proposals for these lines were quite impracticable financially, for even if the promoters of the line took away half of the existing local traffic of the Great Eastern Railway, they would only be enabled to pay 3⅜ per cent. on the debenture stock, and nothing on the ordinary stock. The construction of the lines he estimated would take a net sum of £73,000 from the Great Eastern Company.

Mr. Grinling, the traffic manager of the Great Northern Railway, also gave evidence against the construction of the lines. He contended that the service of the Great Northern Railway supplemented with the arrangements entered into with the Great Northern and Strand Railway and Great Northern and City Railway, would be sufficient to meet the demands of the inhabitants of the districts north and north-east. The North-East Railway would require a gross revenue of £400,000 a year to enable the company to pay 4 per cent. on the proposed capital of £4,500,000, which would mean that 70,000,000 passengers would have to pass over the line every year, or a traffic of 215,000 passengers per day. The line, which was 11 miles in length, it was estimated by the promoters, would carry more than double the whole of the traffic on the Great Northern line, 30 miles long. He could not see how the 1d. fare scheme of Mr. Robinson's would be profitable, for the proposed line would have to face the competition of the North London, Great Eastern and Great Northern Railways, and the tramways and light railways of the Middlesex County Council. The Committee adjourned.

On the Committee resuming its sitting on 12th inst., further consideration was given to the opposition raised in connection with the projected North-East London and City & North-East Suburban Railways.

Mr. Dunn, the general manager of the North London Railway, said that by the interchanges it was proposed to make between the North London Railway and the lines which had been authorised this session, and in previous years, the traffic from the north to the west and east would be amply served. The number of passengers carried over the whole of the North London line during the year was 47,000,000, which was about 128,000 per day, or an average of 160 per train. The entire receipts from passenger traffic on the North London Railway for 1901 amounted to £312,864. He contended that the North-East London Railway would have to earn, in order to pay 4 per cent. on its capital, a sum of £432,713 per annum, which would necessitate the carrying of 151,334 passengers per day, involving the running of 631 trains with 240 passengers in each train—a number which he considered it would be impossible to obtain.

In cross-examination, Witness said the North-East London line would have the advantage of taking people further into the City.

Mr. Pember, K.C., then opened the case for the District Railway and Great Eastern Railway in opposition to the rival schemes. What he wished to put before the Committee was, were not the existing lines of the District Railway, plus its authorised deep level line, plus the authorised Brompton & Piccadilly line, plus the proposed extensions of that line to Charing Cross to Holborn, plus the Great Eastern and other lines serving the east and north-east of London, capable of doing all, or very nearly all, which the proposed rival lines would do? Even if the scheme had slight deficiences in some respect, he believed they were overbalanced by advantages over the others. The only flaw in the scheme, as compared with the United Electric Railways, was that between Hammersmith and Knightsbridge, the United Electric had the chord of the arc, but the gain to the passenger in point of time would not for a moment justify the vast expenditure of £7,000,000 involved in the construction of a new railway from Hammersmith to the City.

Lord R. Cecil, K.C., on behalf of Mr. Walker, of Southgate, also addressed the Committee in opposition to that part of the North-East London line which ran from Palmer's Green to Chase Side, Southgate. He said that portion of the line would do considerable injury to private interests, and there was no necessity from a public point of view for its construction.

The Chairman said the Committee were agreed that they did not require to go further into the opposition of that portion of the line, because on the promoters' own case they did not think the preamble on that portion of the Bill had been proved.

Sir Alex. Binnie was then called by Mr. Frere on behalf of the Tallow Chandlers' Hall. He submitted that he arrived at the conclusion, owing to the age of the Tallow Chandlers' Hall, now some 150 years old, that there would be considerable risk if the proposed line was constructed.

The Committee consulted together, after which the Chairman said they were agreed that that portion of the preamble of the City and North-Eastern Suburban Railway Bill which related to the part of the line running from Whitechapel to the Mansion House, under the District Railway, had not been proved. The Committee wished to know the next morning whether the northern portions of the proposed line would now be proceeded with.

Mr. Page, K.C., intimated that the promoters would consider the matter, and he would inform their Lordships the following morning what course they intended to pursue. The Committee adjourned.

The Select Committee, presided over by Lord Windsor, met again on 13th inst. The Chairman, at the commencement of the proceedings, said the Committee had not considered it necessary to call for any opposition to the Bill of the Charing Cross, Hammersmith and District Electric Railway Company, as the preamble was not considered proved.

Mr. Page, K.C., on behalf of the City and North-East Suburban Railway, said he had considered the declaration of the Committee that the preamble of the Bill was not proved as far as it related to the construction of the line from Whitechapel to the Mansion House. The promoters had, however, determined to proceed with the rest of the scheme and construct a line between Whitechapel and Walthamstow, and they had every hope that further powers would be given them next session to construct a railway which would bring them right into the City from Whitechapel.

Mr. Balfour Browne, K.C., for the Piccadilly and City Railway Company, reminded the Committee that the relations between the Piccadilly and City Company and the City and North-East Suburban Company were so close that they had promised to find two-thirds of the capital of the line to Chingford, and that now, truncated as it had become by their lordships' decision, they no longer regarded the line as part of their scheme.

Mr. Littler said that made the position still worse, for the scheme had now no financial backing.

Mr. Page said with respect to finance, it was obvious that their position had been changed very much by the decision of the Committee and Mr. Balfour Browne's statement. He asked the Committee to defer their decision on the matter of finance till the next day.

Objection was raised to the postponement by Mr. Littler, as he said it would involve an enormous expense.

The Committee having consulted in private, the Chairman announced that the Committee were of opinion that the promoters' case having been closed they could not re-open it. They would be glad to hear Mr. Page the following morning, then finally coming to a decision with regard to the north portion of the North-East Suburban line.

Mr. Littler, K.C., on behalf of the Metropolitan Railway, opposed the construction of the North-East London line, which would run under the existing joint railway of the Metropolitan and District from the Monument to Cannon Street, a distance of 25 chains. He contended that it was manifestly unfair that his company should be competed with on their own soil after spending an enormous amount of money.

Mr. Clode also gave evidence on behalf of the S.E.R. in opposition to the line.

Mr. Balfour Browne said he would submit a clause that might meet the objections of frontagers and petitioners of that kind, which would provide compensation for damage caused by the construction or working of the line during two years. No compensation would be paid to anybody whose property had been paid for. The clause would also suggest a special tribunal to settle questions of damage.

The Chairman said if such a clause was provided it might form the basis of consultation with Lord Ribblesdale and the members of the Committee. The Committee adjourned.

On the reassembling of the Committee on Wednesday last week, Mr. Balfour Browne, K.C., on behalf of the City and North-East Suburban Railway Company, announced that, after giving the matter great consideration, his clients had come to the conclusion that they would not be justified in proceeding with their scheme after the decision of the Committee in respect to the Whitechapel to the City portion. He therefore asked leave of their Lordships to withdraw the Bill from their consideration.

The Chairman said the Committee would allow the Bill to be withdrawn as suggested.

Mr. Balfour Browne then opened the case of the North-East London Railway. He said that the line would run from Ludgate Circus to Palmer's Green, near Enfield, and it would provide a direct through route from the City and the north-east suburbs into the country. The existing railways could not accommodate the traffic which they hoped to get if this line was sanctioned. He was aware that the group of railways, of which the North-East London line formed a part, had been very generally criticised; but he should be able to show that it was a combination which would be able to give the public something in the way of railway facilities which it had not got. It was opposed by a railway "ring" which supported the proposals of the Central London Railway, because they wanted to prevent any competition with their suburban traffic. The present combination was not merely a Morgan group, but associated with it was an English firm of high standing.

The Chairman, at this point, said he would like to say a word as to the procedure the Committee intended to adopt. They had decided to go on with the opposition to all the Bills. First they would hear the opponents of what was termed the Morgan group; then those of the Brompton and Piccadilly Circus Railway, and lastly, the objections to the Central London Railway schemes. When they had heard all the opposition, they would hear evidence from the London County Council and the City Corporation as to their views on the various schemes. Following that, they would hear counsel on behalf of the various Bills. With regard to the opposition of landowners, they would not hear that until they had decided which Bills should be allowed to proceed. By that means much unnecessary opposition might be avoided.

Lord R. Cecil, K.C., remarked that Lord Ribblesdale had requested him to mention to their Lordships that Mr. Moon, K.C., had drawn up and submitted a general clause for the protection of landowners, and that Lord Ribblesdale had also suggested a clause which might form the basis of some agreement. It was distinctly understood that Lord Ribblesdale's Committee would not insert any general clause in any of the Bills before them until they had discussed the terms of the clause with Lord Windsor's Committee.

The Chairman: I will take an opportunity of consulting with Lord Ribblesdale with a view to both Committees adopting the same course.

Sir Douglas Fox was called and examined by Mr. Moon, K.C., on the engineering features of the Brompton and Piccadilly Circus and the Central London Railways. He stated that he had a very strong objection to the proposed connecting link of the Brompton and Piccadilly Circus Railway with the deep level of the Metropolitan District Railway between Charing Cross and Piccadilly. In his opinion such a piece of line would be unworkable, and the effect of the proposed junction at Piccadilly Circus would be to put four tunnels one above the other. Coming to the proposals of the Central London Railway, he wished to reiterate his objection against a closed circuit. He regarded a closed circuit in the centre of London as very objectionable, both from an engineering and a public point of view.

Mr. F. G. Thomas addressed the Committee on behalf of the Metropolitan District Railway Company against the Bills of the Central London Railway and the combined Brompton and Piccadilly schemes. He said that the main objection of the Metropolitan Company to the proposed extension of the Central London line was that it would create a new east and west competition with their railway between the City and Hammersmith. Seeing that the Metropolitan Company were spending a large sum of money in order to work the line by electricity, which they trusted would be effected within the next 18 months, he submitted that it would be unfair to expose them to the competition of the Central London. The Committee then adjourned.

On the resumption of proceedings on Thursday last week, Viscount Knutsford made an important statement relative to the proposed general compensation clause to apply to these Bills. He said the object of such a clause was that for a limited period owners whose lands or houses had not been taken for the purposes of the railway, should be put on the same footing as those owners whose property had been taken, and who could proceed under the Lands Clauses Act. The suggestion he had to make was that it would be desirable to insert in the model clause the words "injuriously affected" from the Lands Clauses Act. The clause, as at present proposed, was as follows: "With respect to compensation for injury arising from the working of the railway to any building where no property of the owner or lessee of such building is taken entitling him to claim for any such injury under the provisions of the Lands Clauses Act, the following general provisions shall have effect; that is to say, if at any time after the expiration of two years after the opening of the railway for public traffic, any structural damage to any such building shall have arisen from the working of the railway, any owner or lessee of such building shall be entitled to recover from the company compensation for such damage proved to have been actually sustained by him in respect of his interest therein," and so on. He (Lord Knutsford) would suggest that the words should be "If at any time after the expira- of two years after the opening of the railway for public traffic any such building is injuriously affected by the working of the railway, then"—and so on. He believed if those words were inserted they would save a good deal of expense and trouble in connection with future arbitrations. He hoped that Counsel would consider the clause with a view to forming the basis of a future agreement.

Evidence was then given by Mr. Ellis, the general manager of the Metropolitan Railway, and by Mr. T. Parker, the electrical adviser, against the Bill of the Central London Railway and those of the combined Piccadilly schemes.

Mr. G. H. Radford said he was chairman of the Parliamentary Committee of the London County Council, and he attended before the Committee to lay before their Lordships the views of the Council upon the various proposals which were under their consideration. It was with much reluctance that they had considered the merits of any particular scheme, because the view of the Council was that it would have been much better in the interests of the general locomotion of London if Parliament had determined upon a complete scheme of tube railways to serve the needs of London as a whole. If that had been done, the Metropolitan could have been divided up into districts and different parts of the scheme taken up by different promoters. In the opinion of the Council it was very desirable that there should be some controlling authority, having somewhat similar powers to those exercised by the Light Railway Commission. Such an authority should inquire into all schemes that were projected for the construction of deep level railways before they were submitted to Parliament. They also thought that a purchase clause should be inserted in regard to these railways, as was the case in respect to tramways, so that if at the end of a term of years the local authority wished they should be able to purchase the lines for the public. They would suggest that the system of shallow tramways, which had recently been sanctioned in this year's Bill promoted by the County Council, might be inquired into as being likely to afford a more cheaply constructed system of underground railways than what were known as tube railways. The Council had considered the various Bills before the Committee, and had come to the conclusion that the proposals of the Central London Railway would best serve the interests of the Londoners as a whole, and that, therefore, the Committee should give preference to that Bill. They believed that if those proposals were sanctioned, they would, together with the existing railway, form a good system of communication from the west to the central districts, and that it would be capable of being utilised in connection with any larger scheme that might be developed later.

Replying to Lord Zouche, Witness said that the Council had considered the Brompton and Piccadilly Circus Bill, and had come to the conclusion that the line would not serve any useful purpose at its western end. The large building estate which the Council had at Tottenham, on which a large number of workmen's dwellings were being erected, would be served by the North-East London line.

Mr. Wheeler, K.C., addressed the Committee on behalf of the City Corporation, and said that they had come to practically the same conclusions in the matter as the London County Council. They thought that the proposed extensions of the Central London Railway would be the best, not only for the City, but for London as a whole. They considered that their stations were more conveniently situated than were the stations proposed under the combined scheme. On condition that the North-East London line went no further than Cannon Street, the Corporation thought it should be passed by the Committee.

Mr. Fitzgerald, K.C., on behalf of the Central London Railway, addressed their Lordships. He said he would remind the Committee that the proposed extension fulfilled all the objects and conditions laid down by Col. Yorke as being desirable in a tube railway—a good train service with simplicity and continuous working. Their line would convey passengers right to the Bank, into the very centre of the City, and none of the other lines proposed to do that.

Mr. Littler, K.C., speaking for the Brompton and Piccadilly Circus Railway, said that in view of the fact that the railway was already authorised, the properties purchased, and the contracts actually let, the Committee would not be justified in giving its sanction to the enormous expenditure which the proposals of the combined companies would involve. He would remind the Committee that the Metropolitan and the District Railways were spending a million and a quarter on electrifying their lines, and he submitted that it would be very unfair to subject them to this competition just at the time when the shareholders were expecting to get some return on their capital. The Committee adjourned.

On reassembling on 16th inst. Mr. Balfour Browne, K.C., addressed the Committee on behalf of the combined scheme of the Piccadilly and City and the London United Electric Railways Company, which provides for a through line from Hammersmith to the City. Counsel said that he thought the Committee would see

that the proposals of the Bills he represented had many advantages over the other schemes that had been presented to their Lordships. In the first place, they would afford a through route, in conjunction with the North-East London line from the crowded districts of the metropolis to the suburbs, and, by taking the people into the outer circle at cheap fares, would help to solve the housing problem which now pressed heavily upon the poor and the working classes. In the second place, they provided two very important services for London, as they would convey passengers from the south-west to the centre, and also they would similarly convey passengers from the north-east either to the centre or through to the west. They also proposed to make a line running from the Marble Arch to Clapham to serve the south-western districts of London, which would give a much needed north and south communication—a thing that was not contemplated by any of the competing schemes. Another advantage he claimed for the scheme was, that it would create a new centre in the City at the Monument instead of increasing the congestion at the Bank. On the question of speed, he would remind the Committee that their trains would average about 19 miles an hour, including the stoppages at stations, which was faster than the Central London Railway. The Central London Company and the Brompton and Piccadilly Circus Company were both alive to the importance of a line from Hammersmith to the City by way of Piccadilly, and they had both tried to prevent any competition by attempting to block that route in their own interests. He did not believe that either of those lines would be constructed even if the promoters obtained the sanction of Parliament, as he was not satisfied with their *bona fides*. The Committee had had ample evidence that if his clients obtained Parliamentary sanction for their scheme, there was no doubt as to their intention and ability to construct the proposed railways.

The Committee having deliberated in private for some time, the Chairman, upon the parties being re-admitted, said: The Committee have decided not to proceed with the Central London Bill as far as it relates to the proposed railway from Shepherd's Bush *via* Hammersmith to the Bank, but they are prepared to consider the extension of the Central Railway Company's line beyond the Bank and the small branch lines at the West end. With regard to the Bill of the Brompton and Piccadilly Railway, the Committee will not proceed with that portion of their proposed line between Piccadilly Circus and Charing Cross, leaving the other portions for future consideration. With regard to the London United Electric Railway, Piccadilly and City Railway, and the North-East London Railway, the Committee will not proceed with that portion of the United Electric Railway which runs from Addison Road *via* Shepherd's Bush to Hammersmith. The Committee will meet on Monday week—May 26th—and then propose to proceed with what further opposition there is to the combined scheme of the London United Company. The Committee then adjourned.

West Ham Corporation Bill.—A Select Committee of the House of Commons, presided over by Mr. Heywood Johnstone, has passed the preamble of the West Ham Corporation Bill, which gives the Corporation power to borrow £25,000 for electric lighting purposes, and £1,300 for tramway purposes. There was also a proposal to construct a tramway along a new street, and the Committee allowed the time for such construction under the Standing Orders to be extended for a period of two years after the completion of such new street.

Donegal Railway.—This Bill, which has already passed the House of Lords, came on 15th inst., as an unopposed measure, before the Chairman of Ways and Means in the House of Commons. Amongst other things, power is taken to work the railway by electricity.

Croydon and District Electric Tramways Bill.—After a lengthy hearing, the Committee passed the preamble of the Bill, with the exception of the Carshalton and Wallington portion of the South and West Croydon extension. They refused the London, Brighton and South Coast Railway control over the connection at West Croydon.

Bexhill and Rotherfield Railway.—The Bill for the abandonment of the Bexhill and Rotherfield Railway came before the chairman of Ways and Means of the House of Commons as an unopposed measure on 15th inst., and was ordered to be reported for third reading.

LEGAL.

Vicar and Churchwardens of St. Mary, Woolnoth, *v.* City and South London Railway Company.

The case *in re* an arbitration between the City and South London Railway Company and the Rector and Churchwardens of the United Parishes of St. Mary, Woolnoth, and St. Mary, Woolchurch Haw, came before Mr. Justice Wright, sitting without a jury in the King's Bench Division, on Wednesday last week. This was a special case stated by the arbitrator, Mr. Vigers, raising the question as to the basis on which the Rector and Churchwardens of the United Parishes of St. Mary, Woolnoth, and St. Mary, Woolchurch Haw, were to be compensated for that part of the site of the church of St. Mary, Woolnoth, which the City and South London Railway Company had taken for the purpose of extending their line from London Bridge to the Angel, Islington. Mr. Balfour Browne, K.C., Mr. Eldon Bankes, K.C., and Mr. Aines appeared for the City and South London Railway Company; Mr. Freeman, K.C., and Mr. Boyle, K.C., for the United Parishes of St. Mary, Woolnoth, and St. Mary, Woolchurch Haw; and Mr. Dibdin, K.C., and Mr. J. Shaw for the Attorney-General and the Ecclesiastical Commissioners.

Mr. Bankes, in opening the case, said that in 1893 the company were promoting a Bill to continue their line from London Bridge to the Angel, Islington, and they scheduled the church of St. Mary, Woolnoth, at the corner of Lombard Street, as a portion of the land they desired to take. That Bill passed without opposition, but the work was not carried out within the time specified, and the company had to apply to Parliament in 1896 for an extension of time. That Act was passed on the condition, as the company contended, that they took not the church, but an easement under it, and certain lands which formed part of the surroundings of the church. In constructing the line, the entire subsoil of the church was excavated, and by a wonderful piece of engineering the building was placed on a steel foundation and preserved. The rector and churchwardens alleged that they were entitled to regard the site of the church as a building site; that for the 1,699 ft. of land outside the church they were entitled to £101,940, which was at the rate of £60 a foot; and that with regard to the land upon which the church stood, the company had so constructed their works as to injuriously affect the site as a building site, and that therefore they were entitled to damages to the extent of £30 per foot, which was 50 per cent. of its value. The arbitrator had, for the purposes of this case, arrived at three alternative findings. He awarded against the company £90,628, if all the lands taken belonged to the site of the church of St. Mary Woolnoth, and could never be used for any other purpose; or £136,421 if the lands taken might have become, under some Act of Parliament, a scheme, under the Union of Benefices Act, 1860, at some future time available for building purposes; or £143,548 if the site of the church and the other land could be made immediately available for the erection of buildings other than a church. He (the learned counsel) submitted that the compensation should be awarded on the basis that all the lands taken formed the site of the church, and could never be used for any other purpose, and that the case should be referred back to the arbitrator, in order that he might explain how the £90,000 was made up. Under the provisions of the Act of 1896, it was clear that the compensation was to be based on the assumption that the church was to remain. The company had expended upwards of £30,000 in providing a steel foundation for the church.

Mr. Boyle contended that the company were at least liable to pay compensation on the basis that the site of the church might at some future period become available for building.

Mr. Justice Wright, at the conclusion of the arguments, said he could not agree with the contention of Mr. Bankes that the claimants were only entitled to compensation on the basis that the lands taken formed the site of the church and could never be used for any other purpose. Under the Union of Benefices Act the site of the church could be made available for building purposes, and, therefore, he thought that the claimants were entitled to compensation on the basis that the site of the church might have, at some future date, become available as a building site—*i.e.*, the second basis.

De Dion Bouton & Co., *v.* Brown Bros., Limited.

In the Chancery Division on Thursday last week, before Mr. Justice Joyce, Mr. Hughes, K.C., moved for an injunction to restrain the defendants from passing off batteries for motor cars as "De Dion" batteries which were not of the plaintiffs' manufacture. Counsel for the defendants said the matter complained of by the plaintiffs had occurred through the oversight of an employé, who acted contrary to the instructions given him. The thing would not occur again. Mr. Hughes said in these cases the matter was always due to an oversight. His clients desired to see the evidence of the defendants, and the motion would have to stand over. His Lordship directed the motion to stand over until next sitting.

CORRESPONDENCE.

Electric Wiring Methods of To-Day.

In the articles and letters appearing under the above heading, great stress has been laid on the desirability of decreasing the cost of wiring. Although this is very desirable, I do not see how any system of screwed conduit is going to help us forward much, at any rate as regards competition with gas-pipe installation costs. Any pipe which is suitable for a watertight conduit, would be equally suitable for gas, and would be cheaper, though perhaps not much, as it would do with less careful attention to smoothness, &c.

Taking the very cheapest job to pipe for, that of an installation with no isolated switches, but only switch lampholders, it would cost more in pipe than the same number of points gas piped, as owing to the necessity of dividing into circuits, several tubes are required, which would come more expensive than the one larger pipe required for the gas. In the ordinary way, many lights are controlled by separate switches, and this is pure extra against the electric system, being almost without parallel in gas practice.

Lastly, the pipe has to be erected more carefully, owing to the necessity of trimming ends of pipes and of making them butt together in the coupling instead of simply screwing them tight in a socket with tapered thread as in gas work, and the work generally has to be of a more finished character, especially at outlets. There is also the cost of draw-in boxes to be added on long or awkward runs.

At present we have, broadly speaking, three styles of conduit to choose from. The steel-armoured insulated conduit, or "Bathurst," which certainly makes a grand job, but which is so terribly expensive, that it is almost out of the question unless ratepayers are finding the money. The Simplex screwed conduit, considerably less in price, a good tube to work, and of a smooth surface, so that wires draw through easily if piping is well fixed. Very pleasant for a workman after steel armoured conduit, as he can keep clean. Thirdly, we have ordinary Simplex, with which ordinary casing may be placed, as they cost about the same to instal, the use of one or the other generally depending on the sort of building to be wired. Both very considerably cheaper than screwed conduit.

We are now to have Armorduct, but I do not at present see how it will affect the ordinary class of work. It seems to be more of a rival to the screwed Simplex class of conduits, and if it can be supplied at a less cost than these, it will be welcome for good work. It will have to be very considerably cheaper before it touches the casing and plain Simplex business. The knock-out box certainly sounds good, as a reduction in the number of fittings is very desirable.

As regards the question of earthing the outer, we have had the argument all on the contractors' side up to the present. It would be very interesting if some of the central station engineers would give us their side of this question. If any objections were fully discussed, they could either be removed or the question dropped.

In the meantime it seems hardly worth while to increase the cost of conduit work by insisting that all should be connected for future use as a return while the prospect of this method being adopted is apparently so remote. Where, again, is the advantage of being able to ultimately double the capacity of an installation? Are we to need twice as much light then as we do now, or are lighting appliances going to decrease in efficiency?

W. H. Isherwood.

Leeds, *May 14th*, 1902.

The Design of Continuous Current Machines.

I am much obliged to your correspondent, Mr. Hiss, for his appreciation and criticism of my remarks on the above subject; but as there appears to be some slight misconception on his part as to the application of my formulæ, I will endeavour to elucidate the points referred to.

In the first place, the *total* flux, *i.e.*, the flux per pole entering armature, multiplied by the number of pairs of poles, is not $\cdot 025\ D^2/100$, but $\cdot 025\ D^2$ megalines. The divisor is introduced for another reason, which I will refer to later.

I certainly was not considering only bi-polar machines, as I do not consider the combination of bi-polar fields and projection type armatures at all satisfactory. Neither should the number of poles make any difference to this factor, which is derived by a simple arithmetical calculation from the total area of the pole shoes, and the flux density in same. Thus, in a four-pole machine, where the length of the pole parallel to the shaft is $\cdot 6\ D$, the angle subtended by same, 60°, and the flux density 40 kilolines, the factor becomes:—

$$\frac{3 \cdot 141\ D \times 60^\circ \times \cdot 6\ D \times 40{,}000 \times 2 \text{ pairs poles}}{360^\circ \times 10^6} = \cdot 025\ D^2 \text{ megalines.}$$

With a six-pole armature of similar dimensions, the pole angle would be 40°, the number of pairs of poles three, and the factor precisely the same.

The factor, $D^2/6$, total gross area of slots, is the maximum permissible under the conditions laid down, and is seldom approached in machines of large dimensions. There is obviously some error in the statement made by your correspondent, that in an instance he tested, the value was D^2, as the total area of the circle represented by the armature core is only $\cdot 7854\ D^2$. For example, the value in the 250-KW. generator, described by Parshall and Hobart, is about $D^2/19$.

Now as to the space and current density factors, the necessity for the introduction of which is not at first sight apparent. The formula for the E.M.F. generated in a continuous current machine may be simply stated as follows:— $M.c.R/50\ p = E$, where M is the *total* flux as previously defined; c the number of face conductors; R the revolutions per second; and p the number of paths through armature from positive to negative brushes. In the case of a two-circuit winding, $50\ p = 100$, the divisor referred to above. The E.M.F. generated by an armature does not, however, enable us to determine the capacity of same, and it therefore becomes necessary to modify the factor, c, in the above formula, so as to arrive at the output in watts.

For this purpose, if we assume a two-circuit winding as before, we may *imagine* there are only *two* conductors on the armature, each consisting of one half the total number of face conductors combined. The sectional area of these conductors (determined from the area of the slots and the space factor), and the current density in same, enable us to fix the limit of output based on these considerations.

There is, of course, no definite relation between these factors and the diameter of the armature. The former generally increases with the diameter, owing to the larger area of the slots, and the greater sectional area of the conductors, while the latter generally decreases. The approximations given are intended to apply to a certain range of sizes only. They are purely empirical, and are arranged to affect only the numerical coefficient of the result, and we are also at liberty to insert actual values in specific instances. In the case of the 250-KW. generator referred to above, the armature being 46 in. diameter, and the length of same only $\cdot 27\ D$, the values are—

$$\frac{\cdot 012\ D^2}{100} \times \frac{D^2}{19} \times \cdot 49 \times 3{,}400 \times \frac{245}{D} = 2 \cdot 57\ D^3 = 250 \text{ KW.}$$

The quantity, 3,400, is, of course, the product of the *actual* current density, and the two *imaginary* conductors previously referred to.

Here is another instance from actual practice, the armature being 18 in. diameter:—

$$\frac{\cdot 035\ D^2}{100} \times \frac{D^2}{6\frac{2}{3}} \times \cdot 28 \times 2{,}000 \times \frac{180}{D} = 5 \cdot 26\ D^3 = 30 \cdot 7 \text{ KW.}$$

The higher value for the flux in this instance is due to slightly increased area and density at pole shoe, which has not prevented the area of the slots closely approaching the maximum. It is particularly interesting to note the low space factor, which means ample insulation and easy winding, and at the same time low current density in the conductors, entirely due to the correct proportioning of the slots.

Tabulation of results in the method indicated, in conjunction with the flux and armature ampere conductors per pole, &c., impart at a glance the most important and salient characteristics of a machine, in a manner impossible by any other method with which I am acquainted.

John H. Hindle.

Manchester, *May 17th*, 1902.

Alternating Current Theory.

I shall be glad if you will allow me to make one or two comments upon the review of my "Elementary Treatise on Alternating Currents" which appeared in your last issue.

Will the reviewer pardon my drawing his attention to p. 98, equations 20 and 22, which have evidently escaped his notice. They supply the relation between primary and secondary ampere-turns and the secondary terminal voltage of a transformer, which are alleged to be omitted. I hope his disappointment will now disappear.

But for the statements respecting the theory of the transformer I should not have made any reference to the review, as it shows evidence of a careful perusal of the book by the reviewer, and is undoubtedly a valuable criticism, and, should I be so fortunate as to issue a second edition, I shall carefully consider its suggestions.

I am afraid the value of the "equivalent sine curve" is not appreciated. I would ask all my readers to remember

that its use is confined to such calculations as involve *mean square* values, and in these, which comprise the majority of practical cases, correct results will follow its adoption. For example, in the formula for eddy currents, to which the reviewer draws attention, the two results are in accord if the maximum induction density is taken to be that due to the equivalent sine current curve.

I do not wish to start a fresh controversy on the "lag" and "lead" puzzle, as to my mind it is a mere quibble. I always give the definition as follows :—One sine curve lags behind, or leads before another of the same frequency, according as a zero (or maximum) value of the first curve occurs in point of time after or before the nearest zero (or maximum) value of the second curve.

I do not wish these remarks to be regarded as a criticism of the review. I should very much like to know the reviewer personally, so as to exchange ideas on several points which are undoubtedly of a controversial nature.

W. G. Rhodes.

Manchester, *May 17th*, 1902.

The Institution and Electrical Legislation.

So far as I am aware, there is no industry in the world which is surrounded with so much legislation and regulation as the British electrical industry. On the other hand, there is no industry which has more to gain by unrestricted development. It is a most curious spectacle—the only free trade country in the world deliberately repressing the only power by whose aid we have any chance of maintaining our commercial prosperity, and affording protection in its most "unintelligent" shape to a number of municipal monopolies. More curious still is the fact that the "man in the street," who, technically speaking, governs the country, has, apparently, no knowledge of these anomalous conditions, and, in fact, has no information as to electrical matters beyond the sensational paragraphs in the popular press, which give him the impression that the British electrician is stupidly incompetent and immeasurably inferior to the American and the German.

With one or two exceptions, the columns of the daily papers are absolutely closed to a fair statement of the grievances of the industry, but any "penny-a-liner" who sends in a paragraph about American syndicates constructing tubes from nowhere to nowhere else, or of German firms supplying machinery at prices suggestive of a clearance sale of old stock, may rely upon seeing the news appear next morning under a "scare heading."

Now, although it does not say so in so many words, the report of the Institution of Electrical Engineers amounts to this :—Given fair conditions throughout the period of electrical development, England would have been at this time—(1) One of the largest, if not the largest, of electrical manufacturing countries ; (2) the country in which the application of electricity to industrial purposes had reached its highest point ; and (3) the country which had benefited most by electric traction.

The difference between what might have been and what is represents so much dead loss to the nation in general and to the electrical industry in particular. Everyone engaged in electrical work, from the most eminent consulting engineer to the humblest wireman, has a direct interest in the removal of the burdensome restrictions which are described in the Institution report, and everyone should endeavour to do something towards the attainment of this end.

Sooner or later the Legislature and the general public will "wake up." They will wonder how they ever came to grant a monopoly in electric power supply to municipalities. And they can only plead ignorance as their excuse. They would never have created a municipal monopoly in steam, and the only difference lies in the method of supply and application, not in the commercial uses. When they find, therefore, that the British manufacturer, with no power available except either his own dear steam, or the municipalities' dearer electricity, cannot compete with foreign rivals, who promptly avail themselves of the best and cheapest supply known to science, we shall perhaps witness an electrical reformation in England. Statisticians may then figure out how many millions of pounds sterling the lesson has cost us.

T. C. Elder.

The Committee which has been considering this important subject appears from its resolutions to have consistently carried through its proceedings the confusion of terms suggested by the reference. The use of the word "Industry" has been misapplied to the object of Mr. Madgen's paper, and the result has been a very one-sided consideration of the whole subject.

The branches of work in which electricity is the main factor may be summarised as follows :—(1) Manufacturing ; (2) Installing ; (3) Working.

I hold that in its strict sense the term "industry" can only be applied to (1), and although (2) may partially come under this term, I think *Electrical Contracting* would be more applicable. However, as regards (3), this should in no wise be considered an industry, as it is almost entirely commercial or financial, depending for its industrial work on (1) and (2), which should be called by a distinctive name, such as *Electrical Undertakings*.

Now either the Committee was intended to inquire into the whole subject covered by these three branches or else into the legislation affecting electrical undertakings only. That Mr. Madgen had the latter object in view when reading his paper is clear, but the interpolation of the word "industry" into the reference has confused the issue and apparently the Committee as well. For instance, examine the "Note of points for the consideration of witnesses," which seems to have ruled the proceedings throughout. The first point inquires as to the cause of the backward condition of the electrical *industry* in the United Kingdom as compared with other countries. Strictly speaking, this refers to (1), yet the remaining six points deal exclusively with electrical supply and tramway *undertakings*, their working regulations and the legislation referring to them. What the above quoted point was intended to convey is not quite clear, but it is hardly surprising that the conclusions of the Committee resolved themselves into a desire to restrict municipal opposition. What this has to do with the backward state of electrical *industries* I fail to see.

Not being personally much concerned in electrical undertakings, I am not competent to criticise the Committee on its findings in this direction ; in fact, I fully accept its views as those of men who have made a real effort to grapple with this aspect of electrical legislation. But I am very much concerned with electrical industries, and as such, I not only cannot concur with the conclusions arrived at by the Committee, but am deeply disappointed at the way it has let this aspect of the subject drop. For the Committee to claim to speak for electrical industry, and then to draw its conclusions from the proceedings of which you give an abstract, is calculated to do much harm. The laws governing electrical undertakings have nothing whatever to do with electrical industries, and any alterations in these laws, however they might benefit electrical undertakings, could in no degree alter the adverse conditions under which the electrical industries exist in the United Kingdom.

Under the circumstances, I hold that the question of electrical industries should be considered exclusively by a special Committee, without any reference to electrical undertakings, and I hope the Institution will see their way to appoint such a Committee at the earliest possible date.

G. Byng.

Cauvery Falls.—The Mysore Government has sanctioned a revised estimate amounting to Rs. 49,44,011 for the Cauvery Electric Power Works. Col. McNeill Campbell, the chief engineer, explains that the excess on buildings for the machinery at the power station is chiefly owing to the depths the foundations had to be taken to find the rock, and to the difficulty in transport of materials. The next increase is on account of the transmission line from the falls to the Kolar Goldfield, a distance of 90 miles. No work of this kind being undertaken in the country before, it was impossible to get accurate results, and much more rock was encountered on the line than was anticipated. The cost of the erection of posts was also under-estimated. A considerable amount of timber had to be procured locally, as the contractors for the supply of Australian wood failed to supply it in time. The total estimate, expressed in sterling, now amounts to £329,601, against a forecast of £287,390.

WORKSHOP RECORDS AND COST KEEPING.*

The two papers, recently read before the North-East Coast Institution, by Messrs. G. Parker and R. P. Link, dealing with workshop records and cost keeping, form a valuable addition to the literature on these subjects, and will be profitably studied by heads of manufacturing works who contemplate the introduction of time-recorders or card systems into their establishments. So long as a firm or company makes large profits, the need for accurate records of time and material is not fully realised; it is only when the shoe of competition pinches that the lack of correct and minute data is keenly felt.

The timeboard, and check systems, are so well known that description is unnecessary here. In each the record is a combination of guess work and memory on the part of the men, generally made in a hurry at the close of the day's work, and, as might be conjectured, often—one might say usually—very inaccurate, in those cases where a man works on several jobs in the course of a day.

Apart from the inaccuracy of the records, there is in large works considerable loss of time due to employés not going direct to their work after putting in their checks or boards, and leaving off work five minutes or so before the whistle sounds. Mr. Link shows that this loss of time, or leakage, amounts to £750 per annum in a works employing 1,000 hands, reckoning five minutes' loss each time of entering and leaving the works.

The up-to-date method of time-keeping is by means of recording clocks, which should be placed as near to the work as possible. Thus in a factory of many floors, there should be a recorder near the centre of each floor, and in a works covering a large area, the area should be divided up into convenient sections, a recorder being placed in each. In some recording clocks each man's number is recorded, by means of a key, on a strip of paper inside the clock, the time being automatically recorded on the strip. One objection to this system is that the numbers are not consecutive.

In another system, each man is provided with a card, which he places in a slot in the clock on entering and leaving the works. On pressing a lever or knob the time is printed on the card, much in the same way as a railway ticket is dated.

Not only may the time of entering and leaving the works be recorded in this way, but, by the use of job cards, the time worked on each job may be also recorded, thus saving a large amount of book-keeping, facilitating the comparison of costs, and providing a very much more accurate record than is possible by the old timeboard or time-book systems.

For the correct recording of materials, a "rough store" and a "finished store" are advisable. All material, whether ordered specially for a particular job, or for stock, should be put through the rough store.

The storekeeper should make independent records of goods or material received, which records should then be sent into the office, to be checked against the invoices. The system usually adopted in this country is to send the invoices to the stores for the storekeeper to check against the stores received. This, however, is a loose method and an incentive to scamp the checking.

By the use of cards, books for the receipt and issue of stores may be entirely abolished. As material is issued only on receipt of card requisition from the foremen, the cards being sent into the office for the use of the stores ledger clerk, the storekeeper has no clerical work to do, except on the receipt of material.

It is not enough merely to know the *total* values of labour and material in connection with any product; these values must be so split up that the cost of any part or member is known. This is accomplished by means of the collective or piece order system, in which a separate card is used for each part. The card may follow the piece through the factory, and have recorded upon it the time spent in the different processes or operations performed on it. It is only by splitting up the costs in this way that the direction in which economies may be effected can be seen.

The works cost of an article does not take into account the standing or establishment charges, and the record and correct allocation of these charges is really a very difficult matter. It may be considered a very simple matter by those firms who simply charge to establishment account everything that cannot be charged direct to orders. This, at best, is a rough and ready method, besides affording absolutely no information when it is desired to ascertain where these charges may be reduced. Only by splitting up the establishment charges into their composite items can the true value of any work be arrived at. Where a firm not only manufactures but deals in its products, it is advisable to keep the selling expenses entirely separate from the working expenses; and such items as rent, rates, taxes, office expenses, &c., should be correctly apportioned to the respective departments. In some American works, establishment charges are split up into over a hundred sub-divisions. This may be thought to be carrying the method too far, and one is inclined to ask if such works merely exist for the purpose of running "card systems." It certainly suggests that we may pay too dearly for our candle. This is the danger.

The subject of depreciation is one of the most important considerations in a manufacturing works, and is the one that, perhaps, best repays the labour of sub-division. Not only should separate records of buildings, machinery, &c., be kept, but, as far as possible, individual machines should be recorded on separate cards, so that it may be easily seen when their value is written off. They can then be scrapped, and the dead records removed.

There are works in this country containing machinery or tools whose value has been written off several times over, but because the individual values do not appear in the records, this fact is not appreciated, and there is a reluctance on the part of the owners to scrap them.

In introducing any system of workshop records, the essential feature to remember is that all orders should emanate from, and all records converge towards the same central source—the office. Further, as Mr. Parker points out, the scope of each official's authority should be clearly defined in order to avoid friction and bad feeling; as whilst this exists, it is impossible for any system, no matter how perfect, to work smoothly and efficiently.

Examples of cards are given in Mr. Parker's paper, and for those who desire to go more thoroughly into the matter, an excellent bibliography of works on the subject is appended.

* Abstract of two papers read before the North-East Coast Institution of Engineers and Shipbuilders, by George Parker (March 21st), on "Workshop Records: A Review and Comparison of Existing Methods, with Special Reference to the Use of Files and Cards instead of Books"; and R. P. Link (April 18th) on "Co-operation and Mechanical Aids to Workshop Cost Keeping."

TUNNELLING FOR ELECTRIC RAILWAYS.

At the Institution of Civil Engineers on Tuesday, March 25th, a paper on "Subaqueous Tunnelling through the Thames Gravel: Baker Street and Waterloo Railway," was read by Mr. A. H. Haigh, B.Sc., M.Inst.C.E.

In passing beneath the Thames the tunnels, elsewhere wholly in London clay, encountered a bed of clean gravel and sand, lying in an abrupt depression of the clay surface. This freely water-bearing bed had necessitated construction under compressed air. The two tunnels, each for traffic in one direction, ran parallel and on the same level for a short distance under the river from the Victoria Embankment, at the bottom of Northumberland Avenue, after which the east (up) tunnel had a rising gradient of 1 in 111, and the west (down) tunnel a falling gradient of 1 in 107 towards the south side of the river. On passing under College Street the up tunnel was vertically over the down tunnel.

The temporary stage, from which the working shafts in the river had been sunk, was constructed on piles, parallel with the Embankment and 150 ft. away from it. From this stage a temporary footbridge led to the Embankment. A stage, 370 ft. by 50 ft., held the contractors' plant and necessary buildings. Two 16-ft. shafts having been sunk, tunnelling northward had been begun from one of the brick chambers at the bottom in February, 1899; but southward the river work had been begun in March, 1900.

The shield for tunnelling through the gravel was provided with a hood in front to cover the men during excavation, and a fountain trap behind, to afford an air-seal against a horizontal water surface, should a run of water at the face threaten flooding of the tunnel. Under the forward top screen of this trap, which was close behind them when working, the miners could escape in case of necessity. The appliance had proved perfectly successful in accomplishing its purpose. Laterally the shield was divided into two halves, ahead of the trap, by a vertical girder, which enabled a limited face in one half to be attacked after any accident to the face-planking due to a "blow." The other essential features of the shield were a steel cylinder, stiffened by a circular box-girder in rear of the hood, and having behind that a strong ring of cast iron carrying 14 hydraulic rams; the cylinder extended behind the rams, forming a tail in which each tunnel ring was built.

The iron lining for the 12-ft. tunnels consisted of rings 18 in. in width. The tunnel was constructed with continuous longitudinal joints, machine faced, and dressed with a mixture of red lead and Stockholm tar before being erected. Joint grooves were caulked with iron-rust cement, and both were grummetted where necessary. Blue-lias lime grouting was forced through the tapped holes provided in the iron, which were then screw-plugged. For regulating the driving of the shield, plumb bob lines for the tunnel centre, graduated side-rods drawn by the shield over fixed index marks square to the centre line, a hanging plumb-line in the shield casting, and boning-rods behind the shield, had afforded every means of determining its position, and information for applying the necessary rams in driving, each ram working independently. Setting-out lines had been taken from a 15 ft. 6 in. base transferred down the shaft by steel wires.

Tunnelling towards Waterloo had been begun at the shaft with 17 ft. of solid clay and 34 ft. of total cover beneath the river-bed. In April, 1900, the 8-ft. solid air-tight diaphragm wall of brick in Portland cement mortar had been built across the tunnel and grouted under pressure, with the working air-lock and an emergency lock through it, and all necessary pipes. When the clay cover of the shield was only 5 ft. thick, the box heading in advance of the shield had been discontinued. Compressed air had then been applied with 5 ft. of clay cover, and at a depth of 18 ft. below the river bed. As soon as the cutting edge reached within 2 or 3 in. of the ballast, pockets of pugged clay had been made, close to each other, in advance of the face, forming a soft bed for the skin to enter, wherever the cutting edge would otherwise have encountered the ballast. As the amount of ballast face increased, the handholes, separately excavated and filled, had formed a larger and larger portion of an annular bed in front, a close blanket against the shield-skin

behind, and a lining to the ballast over the iron tunnel, securing a space for the grout around the iron, and an air-seal at the tail of the shield where it covered the last tunnel ring. The face had been timbered with close horizontal planking set against a thick plaster of pugged clay, and arranged by stretchers in two halves, across the face, held at first against the shield, and afterwards held by up-and-down soldiers, supported by round hollow steel struts passing through the shield, when driving the shield forward. The normal progress of the tunnel in ballast had been three 18-in. rings per day. Three eight-hour gangs had been employed. The air-pressure used had been the exact equivalent of the hydraulic head in the river, varying, usually, during each tide, between 24 lbs. and 32 lbs. per square inch.

Medical attendance had been provided for the workers, and every provision had been made for their care. Cases of compressed-air sickness had been infrequent, and the serious ones few. The amount of air at atmospheric pressure pumped through the tunnel had varied between 30,000 cub. ft. and 200,000 cub. ft. per hour. The proportion of carbonic acid in the atmosphere in the working space had varied between 0·06 per cent. and 0·10 per cent.

The East Tunnel had since been driven through the ballast by the use of the same shield, with a slight modification to enable the miners to work conveniently while the face was kept altogether under cover of the hood. An average progress of over 5 ft. per working day had been uniformly maintained, and the amount of air delivered had averaged only 100,000 cub. ft. per hour.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending May 21st, 1901.		Week ending May 20th, 1902.	
Alexandria	Value £109	Alexandria	Value £51
Amsterdam	220	Amsterdam	178
Bombay	182	Auckland. Elec. cars	7,351
,, Elec. motors	428	Bilbao	90
Buenos Ayres. Teleg. mat. ..	58	Calcutta	160
,, Teleph. cable	1,040	,, Teleg. cable	3,250
Calcutta	1,890	,, Teleg. wire	77
Cape Town	709	Cape Town	3,119
Chinde	52	,, Teleg. mat. ..	20
Durban	1,487	Channel Islands	85
,, Teleg. mat.	663	Christchurch	46
,, Teleg wire	295	Colombo	60
East London	55	,, Teleg. mat.	101
Gibraltar	10	Durban	829
Hamburg	16	East London	1,366
Hong Kong. Teleg. mat. ..	120	Gibraltar	62
Madras	1,048	Hong Kong	49
,, Teleg. wire	14	Madras	215
Mauritius	60	Melbourne	1,005
Melbourne	3,278	North Atlantic. Cable. ..	1,100
,, Teleg. mat.	704	Ostend	20
Ostend	126	Port Elizabeth	28
Perth	240	Rosario	85
Port Elizabeth	101	St. Petersburg	75
Rangoon	269	Santos. Teleg. mat.	250
Rotterdam. Teleg. mat. ..	175	Shanghai. Teleg. apparatus ..	30
St. Petersburg. Teleg. mat. ..	618	Singapore	25
Shanghai	401	Sydney	1,269
Singapore	46	Wellington	112
Stockholm. Teleg. mat. ..	110	,, Teleg. mat. ..	1,422
Sydney	618		
,, Teleg. wire	42		
Teneriffe	48		
Trinidad. Teleg. mat.	25		
Wellington	25		
Total ..	£15,211	Total ..	£22,480

Foreign Goods Transhipped.

arbadoes. Teleph. apprts.	Value £36	Buenos Ayres. Teleg. poles.	Value £252
Rotterdam. Elec. ,, ..	25	New York. Elec. goods ..	230
Trinidad. Teleph. ,, ..	64		
Total ..	£125	Total	£482

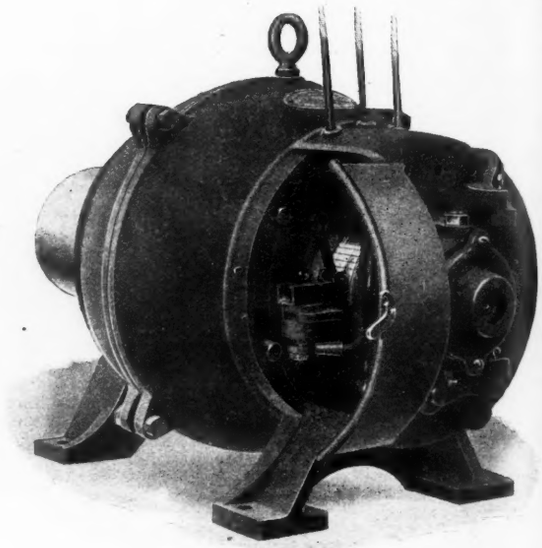
"Ark" Lamps for Boer Camps.—A further number of "Ark" lamps have just been supplied by Messrs. Johnson and Phillips for the lighting of the Boer prisoners' camps, as a result of the previous lamps giving satisfaction. Quick delivery was again a condition of importance, and this Messrs. Johnson and Phillips were readily enabled to comply with, as they keep stocks of all sizes for urgent delivery.

Correction.—Messrs. Booth & Co. point out that their full address is Burleigh House, Yerbury Road, Holloway. The address as given in our last issue was incomplete.

E.L.B. System.—The E.L.B. system of electric lighting has been adopted by the French naval authorities for the illumination of the special squadron, which is at Kronstadt with the President of the Republic. The *Montcalm* has been elaborately equipped with devices and fittings, the representatives of the Electric Lighting Boards Company also being entrusted with the lighting of the special banquetting saloon, and the great dining tables fitted up on this ship for the entertainment of the Czar. It may be remembered that the Czar is personally much interested in the E.L.B. system, and after making some private experiments recently, specially ordered it to be applied for decorative purposes at several State functions.

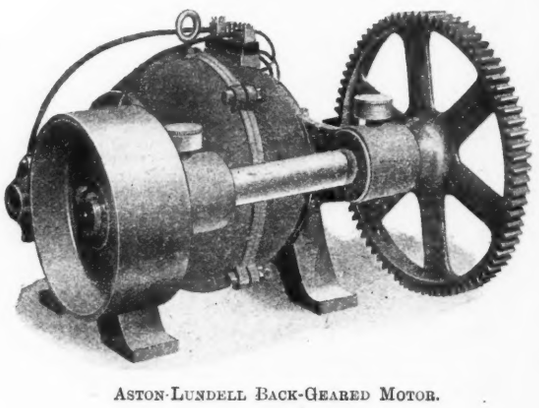
Fire.—Damage to the extent of about £10,000 was done on 14th inst. by a fire in the premises of Messrs. Smith & Co., electrical engineers and oil merchants, 89, George Street, Edinburgh.

Aston-Lundell Motors.—A new list, giving details of their "Aston-Lundell" and "Aston-Standard" motors, has recently been issued by Messrs. Veritys, Limited. The list gives specifications of both types, and full details of outputs, prices, efficiencies, and weights (the latter in pounds and kg.), as well as dimensions packed for shipment in inches and mm. Drawings, showing the principal dimensions, are also given, and numerous



Aston-Lundell Motor.

half-tones and woodcuts to illustrate the details of parts. The standard "Aston-Lundell" motor, which is made in sizes from $\frac{1}{20}$ to 3 H.P., is shown in one of the figures herewith, from which it will be seen that the commutator is completely enclosed, and that the terminals are also situated within the enclosure, so as to be out of harm's way, no live parts being exposed at all. Another view shows the "Aston-Lundell" back-geared motor (reduction ratio 6 : 1); a similar machine is built with worm gear, giving a speed



Aston-Lundell Back-Geared Motor.

ratio of 24 to 1. Above $\frac{3}{4}$ H.P. the motors are wound for pressures up to 500 volts; they are also arranged as D.C. transformers and generators for giving reduced pressures for special purposes. In this connection we would point out that double-wound armature machines are not rotary (or rotatory) "converters," the term being by general and convenient usage restricted to A.C.—D.C. transformers with common armature winding. Full details are given of the "Aston-Standard" motors, semi- and totally enclosed, which are built in sizes from 5 to 100 B.H.P., with or without back gear; Aston starting switches are also listed.

Fire Prevention.—The British Fire Prevention Committee's testing arrangements this month include, on Wednesday, May 28th, a comparative test between a roof covered with slates and a roof covered with vulcanite. The chairman (Mr. Edwin O. Sachs) notified to the National Fire Brigades Union, in the course of their successful gathering last week, that he was presenting a national silver challenge bowl for the smartest fire escape crew, to be competed for on similar lines to the Union's existing challenge bowls for steam fire engines and manuals.

Bankruptcy Proceedings.—An application for an order of discharge was made to Mr. Registrar Linklater at the London Bankruptcy Court on May 15th, on behalf of John George Maxwell Hilton, electrician, Trafalgar Works, Bow Common Lane. Mr. G. W. Chapman, Official Receiver, reported that the bankrupt failed in June, 1899, with liabilities £1,858 10s. 4d., and no available assets. At the beginning of 1895 he became managing director of the Nalder & Harrison Construction Syndicate, in which he invested £2,250, but shortly afterwards the company went into liquidation, and the bankrupt and another person took over the electrical portion of the syndicate's business in satisfaction of their claim against the syndicate. The bankrupt then brought into the business a capital of £2,000, and carried on the trading till the early part of 1897, when it was transferred to a limited company, registered as Nalder & Hilton, Limited, with a capital of £20,000. The partners, as vendors, received £9,000 in fully-paid shares and £6,000 in partly-paid shares, and also became managing directors of the company. In March, 1898, however, in consequence of a disagreement, the bankrupt retired from the company on the terms that he should be entitled to £800 (which was to be applied in reduction of the liabilities of the late firm), and £1,200 in six annual instalments. The bankrupt received some of the said instalments, but he sold his right to £600, part thereof, for £300. He returned to the business in January, 1899, bringing in a further sum of £400 advanced to him by his wife's relatives. In the following May, however, the company went into voluntary liquidation. The bankrupt attributed his insolvency to the failure of the company in the manufacture of electrical apparatus, and to his own want of business experience. The bankruptcy also appeared to be partly due to extravagance. His only income for the last two years consisted of £700 received by him as salary from the company, whereas his expenditure during the same period amounted to £925. His unsecured liabilities included debts of £126 9s. for carriage hire. On the ground of insufficiency of assets to pay 10s. in the £ to the creditors and unjustifiable extravagance in living, the learned Registrar imposed a further suspension of two years. Mr. Mellor attended on behalf of the bankrupt.

Liquidations.—Notice is given that a petition for the winding-up of the Meyra Electric Company, Limited, was presented to the High Court of Justice on 10th inst., and the hearing was fixed for 28th inst., when any creditors or contributors desiring to be heard may appear.

At an extraordinary general meeting of the Westralian Electric Lighting and Supply Company, Limited, on February 25th, a resolution was passed to the effect that the company be wound-up voluntarily, Mr. Gordon Saies, 12, St. John's Lane, Liverpool, being appointed liquidator. The resolution was confirmed at a meeting on March 19th.

Notice is given of an extraordinary general meeting of the Improved Electro-Plating Company, Limited, at the offices of Messrs. Pannell & Co, 13, Basinghall Street, E.C., on June 17th, 11 a.m., to consider an account showing the manner in which the winding-up has been conducted.

Books Received.—"Massachusetts Institute of Technology, Annual Catalogue," 1901—02. Boston: Massachusetts Institute of Technology.

"The Generators of Electricity at the Paris Exhibition of 1900," by C. F. Guilbert. Paris: C. Naud, 1902. 30 fr.

Catalogues and Lists.—Messrs. John Davis & Son (Derby, Ltd.) send us a list of their damp-proof fittings for incandescent and arc lamps, of which a very large variety is shown. Wire and cable reels, lampholders and lamps, pillars and indoor fittings are also priced.

We have received from Mr. Max Kohl, of Chemnitz, a price-list of his new Rontgen ray apparatus, including Wehnelt breaks, tubes, induction coils, mechanical high speed breaks, accumulators, surgical chairs and numerous other accessories.

We have received from the Electrical Co. a new edition of their price list for Nernst lamps. The principal alteration is a very emphatic notice to the effect that "for cases where the voltage rises more than 2 per cent., Nernst lamps for the *next higher pressure* should always be ordered—for instance, 205 volts instead of 200 volts."

Messrs. Alex. Boyd & Son send us a price list of their luminous electric radiators, hot closets, &c., on Boyd's patent. The former are fitted with a shelf or trap, which forms a kind of hot plate, increasing the efficiency of the apparatus as a radiator; an ingenious and useful addition is a wire cage, which serves either as a stand for the radiator, or a cover upon which linen, &c., can be spread so as to dry quickly with perfect safety from fire. Other interesting novelties are also shown and described.

The Electric and Ordnance Accessories Company, Limited, have issued a leaflet showing their "Stellite" Coronation lamp-holder, a simple type of battenholder.

We have received from the Fuller-Wenström Electrical Manufacturing Company a price list of their single-phase induction motors, starting devices, &c. The motors range in size from ½ to 30 B.H.P. without slip rings, and from 2·5 to 55 B.H.P. with slip rings and starting resistances. Full particulars of weight, speed, efficiency, &c. are included.

Messrs. Ferranti, Ltd., have issued Pamphlet No. 152, which describes the Ferranti continuous current meter. The illustrations are excellent, and show various details of parts, as well as some of the machines used in the manufacture of the meter. Special attention is directed to recent improvements in construction, by which alteration of the constant through temporary overloading, entrance of moisture, &c., are obviated, and other advantages are gained.

Charge of Excessive Speed of Electric Cars.—At Ramsgate, on Friday last, the Isle of Thanet Electric Tramway and Lighting Company, Limited, were summoned for propelling a car at a speed of 16 miles an hour instead of only eight miles an hour. It appeared that for five days the police kept observation on the company's cars, and on April 28th the speed of 52 cars was tested. The average speed was 12 miles 1,643 yards per hour, and one car exceeded 16 miles and another 15 miles, while on May 2nd the average speed dropped to 13 miles, five cars exceeding 15 miles. Mr. H. Weigall, the presiding justice, asked if the drivers could keep the advertised times by not going beyond the speed laid down by the Board of Trade, as there were numerous stoppages. Mr. Sharpley, who prosecuted, said he could not go into that. The Ramsgate Watch Committee did not want to be vindictive in any way, but they wanted it to be clear that in future the police intended to take proceedings whenever the maximum speed was exceeded, so as to make the company adhere to the regulations. The company was liable to a penalty of £10 for each of the four offences, but he was willing to withdraw three of the cases on a conviction being made in the first case, and on the company undertaking that the offences should not be repeated. For the defence, Mr. Shea said the company was in a difficult position. On the one hand, they had to comply with the Board of Trade regulations, and at the same time they had to provide the public with an efficient service. If any time had to be made up it would be done in the country district, where no possible injury could occur to the general public. The Bench imposed a fine of £5 and costs in one case, and intimated that in future there would be a fine on every occasion that the law was broken, and a continuing fine.

Damages for Removing a Telephone.—At Llanelly, Carmarthenshire, Mr. J. B. Harries, builder, has been awarded damages of £20 and costs in an action brought against the National Telephone Company in respect of injuries alleged to have been sustained by defendants' removal of a telephone; £50 was claimed. Plaintiff on returning home after being away found the instrument gone, and was subsequently told that this had been done on his brother's instructions; but the brother had no authority in the matter.

Economical and Smokeless Steam Raising.—We have received a well got-up booklet from Messrs. Meldrum Bros., Limited, descriptive of their "Koker Stoker" in combination with their system of forced draught. The theoretical considerations underlying the efficient combustion of fuel are clearly set forth. It is, or should be, the ambition of every steam engineer to get not only every ounce of steam that it is possible for his boilers to evaporate, but to get this maximum output with the lowest consumption of fuel, and to burn his fuel without producing smoke. Any of the three objects may, without much difficulty, be attained independently, but to get these results simultaneously is a matter not so easily accomplished. Boiler efficiency is often sacrificed for fuel efficiency, which means a low rate of combustion per square foot of grate, the boiler evaporating considerably below what it might do. A thicker fire would, unless precautions were taken, mean a smoky chimney. A mechanical stoker, on the coking principle, whilst producing comparative smokelessness, may do so, and generally does so at the expense of boiler efficiency, that is, by a low rate of combustion. By combining the best features of the coking stoker with their special system of forced draught, Messrs. Meldrum Bros. claim to have entirely overcome this drawback, and substantiate their claims by figures of tests. The following figures refer to a test made on a Babcock & Wilcox boiler at the Bristol Corporation Electricity Works. The total heating surface was 2,852 sq. ft., and the grate area 55¼ sq. ft. The duration of the test was six hours:—

Kind of fuel	Rhymney Washed Peas.
Coal consumption per hour per sq. ft. of grate...	28·23 lbs.
Feed water temperature	100° F.
Steam pressure	120 lbs.
Actual evaporation per pound of coal	9·64 lbs.
" " " " from and at 212° F.	11·2 lbs.
Percentage of clinker and ash	11·8 %
" " CO_2 in flue gases	9·8 %
" " O " "	8·6 %
" " CO " "	*Nil.*

Imports of Foreign Electrical Plant.—The official returns relating to the imports of "foreign electrical goods and apparatus" into this country during April last are now available. Although showing the largest monthly total recorded so far this year, the imports are behind those during the same month of 1901, having amounted to £65,363, as contrasted with £47,158 in March last, and £86,629 in April a year ago. During the four months ending April last, the imports reached a value of only £230,341, which compares with £408,318 in the corresponding four months of 1901.

Installations.—Messrs. Baxter & Caunter, of 5, Macclesfield Street, W, inform us that they have secured the contract for the lighting plant at Messrs. Gamage's, consisting of three 75-KW. sets, Reavell engines coupled to Taunton dynamos. They have also secured the contract for Guildford, to supply a 250 KW. Willans-Taunton steam dynamo.

Holiday Resorts.—The time is approaching for the selection of a haven of refuge from the stress of business and the din of machinery, and a booklet just issued by the Great Eastern Railway Company, describing the attractions of the Eastern Counties, is highly *à propos*. It is beautifully illustrated, and cannot fail to induce many holiday makers to spend their vacation in East Anglia.

Lorain Steel Company.—We understand that the Westinghouse Electric and Manufacturing Company has acquired the electric railway business of the Lorain Steel Company, at Lorain, Ohio, formerly carried on under the name of the Steel Motor Company of Johnstown, Pa.

Outing.—On 10th inst. the Electrical Staff of Messrs. Ogden's, Limited, held their second annual pic-nic and sports at Eccleston. In the morning a drive of 15 miles was arranged, followed by an excellent dinner at Chester and a very enjoyable trip up the Dee. The sports, which were highly successful, were then carried out, and the party returned home *viâ* Chester.

Sales.—Wimbledon.—May 28th. Tenders are wanted by the U.D.C. for scrap cable ends, old fire bars, &c.

Leyton.—June 25th. The U.D.C., having adopted steam plant, wants tenders for its disused gas plant, comprising three vertical boilers, five Dowson gas generators, with accessories, two gas-holders, eight gas engines and dynamos, piping, &c. See "Official Notices" to-day.

The sale of the stock and plant of an electrical engineer on 29th inst. is announced by Messrs. Percy Huddleston & Co. For particulars see our advertising pages.

Trade Announcements.—Messrs. W. Macdonald & Co. give notice that all communications, letters and returned empties must in future be addressed to 118, Queen Victoria Street, where they are moving into larger offices. Their temporary telephone number during the change is 5507 Bank.

Messrs. Connolly Bros. inform us that they have appointed Messrs. R. A. Whyte & Co., of 140 and 144, Bath Street, Glasgow, to be their agents for Scotland.

ELECTRIC LIGHT AND POWER NOTES.

Aberavon.—At a quarterly meeting of the T.C. last week the Council resolved that terms be arranged with the South Wales Electric Power Distribution Co. for the purchase in bulk of electricity at 2¼d. per unit.

Abersychan.—The D.C. has been offered the supply of electrical energy in bulk at 2½d. per unit by the South Wales Electric Power Distribution Company, and is considering the question of obtaining a prov. order to purchase in bulk and distribute.

Birkdale.—The E.L. Supply Company are getting well forward with their work in Birkdale and district. The electric station is nearly completed, and the current, it is hoped, will be supplied throughout the district by July.

Bolton.—According to the annual accounts of the electricity department, the output has increased as regards lighting, tramways and power, from 2,431,739 units to 3,120,700 units, an increase equivalent to 28 per cent. on the previous year. The small output of the previous year for motor purposes has been almost trebled, but notwithstanding the increase in the output, the quantity of coal used is less by 467 tons, viz., 12,171 this year. The gross revenue during the year just closed was £29,800, against £24,096 in the previous year, whilst the cost of production during the year ending March, 1901, was £13,549, and during last year £12,481, a diminution of £1,468. The gross profits have increased to £17,319 from £10,544 the previous year. Out of this gross profit there have been paid in interest £4,912, and sinking fund £7,655, leaving a balance of net profit of £4,752, equal to 3 per cent. on capital. Out of this £3,850 has been voted to the relief of rates, and £902 carried forward. For March 31st, 1902, the capital expenditure is set down at £180,258, the sinking fund paid is £21,209, thus bringing the total to £159,049. There is in the station 2,800 KW. of plant installed, which works out on the capital expended at £64 7s. per KW. There are in the country several large stations, company and municipal, whose capital stands at over £100 per KW. The cost of production at Bolton stands at ·96d. per unit.

Cults.—Messrs. Lowden Brothers & Co., of Dundee, have purchased the electrical supply undertaking established some few years ago at Cults. The works comprise buildings, boilers, engines and dynamos, accumulators, and a complete system of distributing mains. The agreement concerning the lighting of the village which has obtained with the C.C. has been continued, and Messrs. Lowden will take over the installation as a going concern.

Dacca.—A license has been granted to the Dacca Electric Lighting Trustees for installing the electric light in that town.

Demerara.—At the annual general meeting of the Demerara Electric Company, Limited, of British Guiana, last month, it was stated that this company has now a monopoly of the light, power and tramway business in Demerara, as the gas company has been forced to close down and wind up its affairs. The electric plant is being extended to take up the increased business offered.

Germany.—Messrs Körting Bros., of Hanover, have secured a contract to establish a central electric lighting station and an electric tramway in the town of Coburg.

The municipal authorities of Quedlinburg are raising a loan of £20,000 for the purpose of establishing a central electric lighting station in the town.

Godalming.—The T.C. on the 5th inst. decided to accept the offer of the Urban Electricity Supply Company for street lighting.

Guildford.—In reply to communications from the Town Council, the Guildford Electric Supply Company, Limited, has offered to transfer its undertaking to the Corporation at a valuation to be agreed upon plus £10,000 for goodwill. The total capital expenditure has been £26,855, and machinery to the value of £4,000 is on order. In view of the fact that last year's net profits were only £841, and that the instalment on a loan of £40,000 would mean an annual payment of £2,700, the Council decided not to entertain the company's offer.

Hamilton.—At the monthly meeting of the T.C. on 13th inst., the E.L. Committee reported the acceptance of the price offered by Messrs. Edmundson for the generating station at Almada Hill, inclusive of buildings, for £32,302. The report was adopted.

Heston—Isleworth.—The U.D.C. has instructed Mr. J. Enright to report on the subject of electric lighting and submit a provisional scheme at a fee of 30 guineas.

Leatherhead.—The Leatherhead and District Electricity Company's new works are in an advanced stage, and energy will be available for consumers on July 1st, on which date the company is under contract to supply 1,200 8-C.P. lamps at the new Blind School. The generating plant includes two Paxman high-pressure boilers with superheaters, and two high-speed vertical 50-H.P. engines, directly coupled with the dynamos, which will work at full load all day, charging the batteries, which are of very considerable capacity. Cables are to be laid forthwith, and are being planned with a view to be available for the outlying parishes of Ashtead and Mickleham. The company have offered to light the streets on the scheme recommended to the Council sometime ago, and on the terms then calculated as being those for which the Council could do the work. The charge to consumers will be 7d. per unit for lighting, and 4d. for motive power. A limited number of premises will be wired free up to four lights, and penny-in-the-slot meters supplied. Messrs. Handcock & Dykes are the consulting engineers.

Little Woolton.—An inquiry was held last week into the application of the U.D.C. for leave to borrow £1,800 for electric lighting purposes. Current would be supplied by the Garston and District Electric Supply Company.

London.—Shoreditch.—At the meeting on Tuesday, May 6th, of the Shoreditch Borough Council, the Lighting Committee reported having considered a letter from Messrs. Turner and Co., solicitors, stating that they had been instructed by certain ratepayers to apply to the High Court for an injunction restraining the Council from carrying on the business of dealers in electrical accessories and requesting attention to be given to the matter. The Committee recommended that the communication be simply received, and this was agreed to. It was further reported that during the past four quarters £38,366 13s. 11d. had been received for energy supplied, work done by the wiring and fitting department, &c.; £10,820 10s. of this was the lighting of public offices, weekly accounts, &c. It was also reported that the new generating station in Whiston Street will be opened on June 16th.

Paddington.—The Electric and Gas Committee recently presented a report stating that it had been in communication with the Metropolitan Electric Supply Company relative to the price charged for lighting Westbourne Terrace with electricity. At present the company supplied for the sum of £30 per arc lamp per annum, the energy, lamps, mains, carbon and all labour involved in the trimming and maintenance thereof; 14 lamps being in the thoroughfare, the total sum paid was £420 a year. The company, having regard to the small number of lights installed, declined to reduce their charges. Pursuant to instructions, the surveyor of the Council prepared schemes for the re-installation of a system of gas lighting, and the Committee recommended that the Council adopt such a scheme, but the question was adjourned for six months.

Southwark.—The M.B.C. has received a letter from the County of London and Brush Provincial Electric Lighting Company, Limited, offering to supply energy for all-night public lighting in bulk at a flat rate of 2d. per unit. The communication was referred to a committee.

Marylebone.—An arbitration inquiry under the Lands Clauses Acts is proceeding before Mr. C. A. Russell, K.C. (umpire), Mr. Robert Vigers, and Mr. W. C. Ryde (arbitrators), at the Surveyors' Institution, Great George Street, Westminster, to decide the amount to be paid by the Marylebone Borough Council to the Metropolitan Electric Supply Company, Limited, for the acquisition by the Council of that portion of the company's undertaking situate in the borough. The counsel employed include (for the Metropolitan Company) Mr. Balfour Browne, K.C., Mr. Cripps, K.C., Mr. Ernest Moon, K.C., Mr. C. H. Sargeant and Mr. A. T. Lawrence (instructed by Messrs. Barlow & Barlow); and for the Borough Council, Sir Edward Clarke, K.C., Mr. Fletcher Moulton, K.C., Lord Robert Cecil, K.C., and Mr. A. B. Kane (instructed by Messrs. Green-

well & Co.). The amount claimed by the company reaches the enormous sum of £2,771,708, apart from what is claimed under the compulsory purchase clause. The inquiry at present stands adjourned to 26th inst. The opening proceedings consisted of a statement by Mr. Balfour Browne, who gave a history of the company and of its electrical association with the borough of St. Marylebone, after which Mr. J. Conacher, manager of the Metropolitan Company, was examined.

Loughborough.—The T.C. has decided to apply to the B. of T. for a further extension of the time within which the electrical powers of the Corporation are to be carried into effect.

Lowestoft.—At a T.C. meeting the resident electrical engineer, Mr. Bruce, reported that there are now 11,495 8-C.P. lamps connected. The Local Government Board has granted the loan of £7,143 for a new 500-KW. set and condensing plant.

Macclesfield.—According to the *Contract Journal*, the T.C. is favourably considering an offer from a syndicate to lease electric lighting powers from the Corporation, and to construct electric tramways in the town. The scheme is a large one, including connections to other towns within the influence of Macclesfield, and involves an estimated cost of £500,000.

Morecambe.—The U.D.C., which has received a preliminary charter of incorporation, has resolved to adopt the suggestion of Mr. Pape, electrical engineer, and stock prepayment meters. An additional sum of £3,500 has been borrowed for the extensions and East Street sub-station. It was estimated that the undertaking would burden the rates to the extent of £2,178, but the deficit only came to £1,632. The revenue for last year increased by £177 1s., and the gross profit by £120 17s. 5d. The amount repaid in principal and paid as interest during the year was £3,356 11s. 7d., against £2,281 2s. 9d. last year.

Newport.—The year's working of the electricity undertaking was reported last week to have resulted in a profit of £859, as against a deficit of £2,760 on the preceding year. There were 570 consumers, or an increase on the year of 121, and the explanation of the difference in the two years was not coal, but management, as the working expenses were £1,208 5s. less. The total sum earned for the year was £12,323 6s. 2d.; cost of works, £5,892 10s. 6d.; interest and sinking fund, £5,571 12s. 7d. The capital expenditure of the year had been £5,328; whilst the capital expenditure up to date on the undertaking had been £102,882.

Newry.—The U.D.C. has refused the application of Messrs. R. Foster & Co. for leave to lay a cable under the street from Messrs. H. Thomson & Co.'s premises for a supply of electricity. Messrs. Foster ought now to carry the cable overhead *without* leave.

Poland.—The Schuckert Company, of Nüremberg, has prepared plans for a projected central station for electric lighting and power purposes in the town of Warsaw.

Pontypridd.—One of our Welsh correspondents, referring to the deadlock between the South Wales Electrical Power Distribution Company and the Pontypridd Urban Council on the subject of electrical supply to the town, and the absurd attitude of the local Council in conceiving that it can supply the energy at a lower rate than a great company like the Welsh company, writes that the Council is now being pressed to consider another very important point. The company has the absolute right to lay its mains through every street in the town, and it is not at all likely that it will allow the Council to supply energy for lighting at 3½d. per unit, and for power at 2d. per unit, when it can supply energy for both purposes at 1¾d. per unit. The L.G.B. has recently twice refused a loan for electricity supply to a corporation to which a great power company had offered to supply in bulk at 2¼d. per per unit. The South Wales Power Company offers energy to the Pontypridd Council at 1⅜d. per unit, and there is a probability that the Council will ride for a fall if it insists on going before the L.G.B. for a loan. By accepting the company's offer, the Council will, by figures before the public, not only save a considerable yearly sum, but will also be saved a capital expenditure of over £30,000. The Rhondda and the Bridgend District Councils have seen the wisdom of this step, and the Barry Council is negotiating.

Portsmouth.—The E.L. Committee has not only wiped out the £800 deficit of last year, but has a balance in hand of about £3,500, so that over £4,000 profit has been made.

Spain.—A company has just been formed at Alcala de Henares to establish and work a central electric lighting station in the town. At first, a 60-H.P. Crossley gas engine and dynamo are to be installed.

It is proposed to put down plant to utilise the water-power of the River Sinca at Ballobar in the generation of electrical energy for lighting and power purposes. Application has just been made for the necessary concession.

The U.S. Vice-Consul at Madrid reports that a new electrical company has been formed in that city, with a capital of 6,000,000 pesetas, for utilising for illumination, motive power, traction, heating, &c., the energy of a waterfall in the Jarama River, situated at a distance of 11 miles from Madrid. About 3,000 H.P. will be developed.

Spennymoor.—The B. of T. approved the test of the cables on the 12th inst., and the Northern Counties Electricity Supply Company are now about to supply current to about 2,000 lights.

Swansea.—Messrs. Vivian & Sons have applied for motive power to drive their extensive plant at Hafod Tyha nickel works. This is about the first application of the kind that has been made, and the possibilities of development in such an industrial centre as this, of this particular form of power, cannot be overestimated.

Surbiton.—At a meeting of the D.C. last week it was resolved that the agreement with Messrs. Callender be sealed by the Council and instructions given to Messrs. Callender to commence the work at once.

Swindon.—The Corporation has decided to apply to the B. of T. for one year's extension of the time allowed by the prov. order for the completion of the Council's scheme for electric lighting and traction. The tender of a Manchester firm for the supply, delivery, and laying of feeder and distributing cables, conduits, &c., for £5,411 1s. 1d. has been accepted.

Valparaiso.—The Chilian Legation at Paris is receiving proposals for lighting Valparaiso and working the tramway lines by electricity.

Welsh Coal Mining.—The developments in connection with the South Wales Electric Power Distribution Company are bringing the question of an extended utilisation of electricity in coal mines into great prominence. Already electricity is largely used in a number of Welsh collieries for lighting the surface and the pit bottom and for underground haulage—the latter under qualified conditions of radius. At Cwmoman Colliery, for instance (in the Aberdare Valley), there are two electric plants, and the management is arranging to put up a small haulage plant as well. Expert opinion seems to indicate a large opening for the use of electricity in what is known as "secondary haulage" in the Welsh coalfield, and indeed there is a strong belief that as soon as the Distribution Company is prepared to supply electric power, it will be largely used in many Welsh collieries for at least all intermittent work. And there are still wider possibilities ahead.

ELECTRIC TRACTION NOTES.

Austria.—An electric tramway has lately been completed in the town of Marienbad. The line, which was opened for traffic on the 14th inst., has been built by Messrs. Ganz & Co., of Buda-Pesth, for the Marienbad Municipal authorities.

Belgium.—The Railway Commission of the Senate has been informed by the Government that the latter has decided to accord the concession of the Brussels—Antwerp electric railway to private enterprise. This decision has been taken after due consideration of the peculiar circumstances which govern the working of the proposed line, and which impose the condition that the Antwerp—Brussels line should be worked more as an inter-urban tramway than the section of an international line, even in the event of the electrification of the various railways of the State, a project at present being studied by the department.

Birkenhead.—At a meeting of the T.C. last week, Mr. P. W. Atkin asked whether it might not be advisable to use petroleum oil for sprinkling the tracks? Experience in other places had shown that by using petroleum on the track they could get rid of the dust, and the use of petroleum would have a good effect on the blocks, as it would prevent them from shrinking or swelling.

Carshalton.—Members of the U.D.C. who attended at the House of Lords to give evidence in favour of the B.E.T. Co.'s Bill, have been very outspoken in their comments at not being permitted to give evidence, and think that the local portions of the Bill would have been passed had they been allowed to speak on local needs.

Cheltenham.—Considerable discussion has taken place as to whether Gloucester or Cheltenham shall be the centre of the system of electric tramways which Mr. Nevins is about to construct in Gloucestershire. The point at issue is whether the line will be permitted to run through High Street, Cheltenham, opposition having been raised on the ground that the trams will interfere with customers who desire that their carriages may remain for a short time outside shops whilst their aristocratic owners are making purchases. It is pointed out in the local press that although the convenience of all classes of society should be considered as far as possible in these matters, it will not be politic to allow a minority of the community to stand in the way of what will undoubtedly be a boon to the great majority.

The Cheltenham T.C. has investigated a charge made against Mr. Hall, the borough surveyor, to the effect that, whilst he had agreed to devote his whole time to the work of the Corporation, he had done work for—and accepted money from—Mr. Nevins in respect of the laying of the tramways. At a special meeting of a select committee appointed to deal with the accusation, Mr. Hall admitted having received £1,000, but contended that of this amount £653 was swallowed up by out-of-pocket expenses. The committee in their report state that, whilst acquitting Mr. Hall of any corrupt or unworthy motive, they regard his acceptance of the money as a serious breach of his engagement to devote his whole time to the business of the Corporation.

The Light Railway Commissioners last week resolved, after holding an inquiry, to recommend the B. of T. to authorise a suburban extension of about eight miles of the present light railway system at Cheltenham. The scheme, which will cost £120,000, was opposed by several people on the ground that it would destroy the character of the town and drive away the residential classes! Evidence in support of the extensions was given by Mr. Edward Dodd, of Birmingham.

Gloucester.—The R.D.C. has been approached by the City Authority, the County Council, and by Mr. Nevins over the dispute as to whether the latter or the city authorities shall have the right to work electric cars over a small piece of roadway just outside Gloucester. The rural body, after a considerable discussion, arrived at a decision which, whilst neither favouring one scheme nor the other, expressed approval of electric tramways and advised the parties concerned to consider the interests of the public by coming to an amicable understanding. Both the city and county authorities have issued the statutory notices, and the latter has decided to convene a special meeting, when an amicable settlement may be arranged.

Heston—Isleworth.—The U.D.C. has approved the plans of the L.U.T. for their authorised tram line along Staines Road, Hounslow, to Baber Bridge.

London.—ALEXANDRA PALACE.—Mr. Chas. Townley, one of the Islington trustees of the A.P., protests against the statement that the trustees are unanimously in favour of an electric railway. The statement, as issued by Mr. R. M. Littler (chairman of the trustees) refers to the electric railway which formerly carried passengers from Wood Green to the Palace, and the trustees having been urged to reconstruct the line, "the whole of the trustees are in favour" of the same. The route proposed by the Middlesex County Council will be in two portions:—

1. A line, in physical connection with Finsbury and Islington, turning off in the Green Lanes, and traversing Turnpike Lane, Hornsey, and Priory Road, to the Hornsey Gate.
2. A short line from Wood Green over the Great Northern Railway to near the Wood Green Gate, and connected with Enfield, Edmonton and Tottenham.

The machinery for working the railway will be placed in an annexe to the Palace, and will be considered as a subject for public exhibition. It is also proposed to light the Palace from such machinery, and if possible start a technical school of electrical engineering under the Middlesex County Council. It is also stated by Mr. Littler that the majority of the trustees are in favour of electric lifts from the light railway termini up the hill, for no tramway is to be allowed in the Park itself.

London Underground Railways.—The Committee of the House of Lords, presided over by Lord Ribblesdale last week, concluded its deliberations on the ten underground electric railway Bills which had been remitted to it. The following are the Bills considered:—

Charing Cross, Euston & Hampstead (Nos. 1, 2 and 3)	Passed.
Edgware & Hampstead	Passed.
Islington & Euston	Rejected.
City & Crystal Palace	Rejected.
Great Northern & City	Passed.
Great Northern & Strand	Passed.
North-West London	Passed.
Baker Street & Waterloo	Passed.

The three last named only sought extension of time for the completion of authorised lines. The Charing Cross & Hampstead, the Edgware & Hampstead, and the Great Northern & City embrace about 9 miles of line, with a capital of something approaching five millions. The two rejected schemes would have measured nearly 10 miles between them, and their capital would have been about 5½ millions. In the group of tube railway Bills which is before Lord Windsor's Committee, the withdrawal of the City & North-East Suburban Bill in consequence of the Committee having refused to sanction the City end of the line, marks the death of the second Bill in this group, the Charing Cross & Hammersmith measure having previously been rejected. These two railways would have aggregated over 20 miles of route, and some eight or nine millions of capital was proposed.

Mandalay.—The Burma Electric Works Syndicate has asked for an extension of time to construct the electric tramway, which is to be commenced before December 6th, 1902, and to be completed before December 6th, 1905.

Mersey Railway.—According the *Morning Post*, the Westinghouse Machine Company of East Pittsburg is about to make a shipment of machinery for the new power station of the Mersey Railway, which is being adapted for electric traction by the Westinghouse Electric and Manufacturing Company. The shipment will consist of two cross compound engines of 2,000 H.P. each, and two 1,200-KW. generators to be connected directly with them. The company is about to double the productive capacity of its works at Pittsburg, at a cost of £300,000.

Mexico.—La Compagnie Industrielle de Guadalajara is about to construct an electric tramway between the town of Guadalajara and the suburb of Analco.

North Metropolitan Tramways.—According to the *Daily Chronicle*, it would appear that the British Electric Traction Company, having come to an agreement with the County Councils of Middlesex and Hertfordshire, is prepared to absorb the North Metropolitan Tramways Company's undertaking. The Middlesex County Council has already agreed to hand over the greater part of its district on a 30 years' lease to a private undertaking, that in the case of the Hertfordshire County Council being of 12 years longer duration. The lines which have been authorised, or for which applications for authorisation are pending, include the greater portion of north and north-east Middlesex, with some parts of Hertfordshire, and the promoters have recognised that the new system would be incomplete without such a "feeder" as would be supplied by the lines of the North Metropolitan Company, hence the offer which has been made to the shareholders in this company. The London County Council already owns the bulk of the North Metropolitan lines, and in eight years' time the lease which the company now holds will expire. If, in 1910, the Council is in the same mind as at present, that lease will not be renewed, and the traffic will be worked direct. But, in the meantime, the Council has deposited its plans for the electrification of all the lines, and this will have to be carried out in any case. All that the new arrangement will secure will be the lines in Hornsey, Tottenham, and Edmonton, which are purchaseable in 1905, the unexpired lease of eight years, and the plant and rolling stock of the old company.

Nottingham.—The Woodborough Road—Mapperley section of the Corporation electric tramways was opened for traffic on 13th inst.

Oldham.—The formal opening of the Oldham Corporation Electrical Tramways took place on Monday. The full scheme, which will consist of 21 miles of route, and a total length of single track of 30 miles, has not yet been completed. Electric cars now run from Hollins Road, round by Copsler Hill Road, Ashton Road, and King Street to the borough boundary at Chadderton, from the boundary at Hollinwood to the boundary at Waterhead, from Lees-brook to Mumps, and on a circular route from the Star Inn by Park Road, Mumps, and Union Street—12 miles in all. The lengths not yet open are from Middleton Road to the Royton boundary, Featherstall Road section, from Ripponden Road to Moorside, and Shaw Road and Egerton Street. At the invitation of the chairman and members of the Tramways Committee, a large number of ladies and gentlemen assembled at the Town Hall, and subsequently proceeded in eight special and gaily decorated cars to Hollinwood. The first car was started by Mrs. H. Chadwick, wife of Alderman Chadwick, chairman of the Committee, and the second by Mrs. J. A. Hanson, wife of Councillor Hanson, vice-chairman. At Hollinwood, and again at Waterhead, Councillor J. A. Hanson declared the route, which was only passed on 15th inst. by Major Druitt, of the Board of Trade, open to the public. The party then went to Wallshaw car depôt, where the Mayor, Councillor J. Eckersley, unveiled a tablet containing the names of the members of the Committee and the officials, and Alderman Chadwick formally opened the car depôt. Luncheon was afterwards partaken of at the Town Hall. The tramways in Oldham were originally constructed by the Corporation under Parliamentary powers. The first section running throughout the town was laid in 1880, and was constructed for horse traffic. An extension was made in 1884, a track being laid north and south across the borough suitable for steam traffic. The sections were leased separately on completion to two different companies, the leases being arranged to terminate on October 31st, 1901, when power to use and work the same reverted to the Corporation. The Corporation obtained powers for reconstructing the existing and laying fresh routes. The following is a brief summary of the estimate presented at the Board of Trade inquiry:—New routes (including land for car depôt), £91,891; reconstruction of old routes, £91,778; electrical equipment, £37,901; car depôt at Mumps, £27,102; cars, £121,500. Supplementary estimate (to be presented to the B. of T.):—Reconstruction of old routes, £17,316; electrical equipment, £11,520; car depôt at Neville Street, £28,026; total, £427,034. The Barrow Hematite Steel Company, Limited, have supplied 2,000 tons of rails, and Messrs. Dick, Kerr & Co., Limited, are now completing a 3,000 tons contract. Approximately 183 pairs of points and 279 crossings have been used in the track laid down. Messrs. Glover & Co., of Salford, have been the contractors for the bonds, and up to the present have supplied about 12,000. The cables are manufactured by Messrs. W. T. Glover & Co, Ltd., and the insulation is impregnated paper, lead-covered. It is proposed to fix telephones to each section pillar, communicating with the car shed. The manufacturers of the trolley wire are Messrs. Smith & Sons, Anaconda Works, Salford. The overhead fittings are mostly supplied by Messrs. Estler Bros. Guard wires are fixed where necessary. The car depôt at Wallshaw was constructed to accommodate 70 cars. There are eight tracks into the depôt diverging from a single track at the entrance. There are workshops at the end of the building. The construction of the track, building of depôts, erection of standards and overhead equipment and cables, have been designed and carried out by Mr. S. A. Pickering, borough engineer, with Mr. H. Clegg as his assistant. Messrs. Hewitt & Rhodes, of Manchester, have acted as consulting electrical engineers for the overhead and underground equipment, as well as for the cars and car shed. The whole of the track was constructed by Corporation workmen. The contractors for all other work are as follows:—Electrical equipment, Messrs. W. T. Glover & Co., Limited, Manchester; rails, fishplates, &c., Messrs. The Barrow Hematite Steel Company, Limited, and Messrs. Dick, Kerr & Co., Limited, London; points and crossings, Messrs. Askham Bros. & Wilson, Limited, Sheffield; cars, Messrs. the Electric Railway and Tramway Carriage Company, Limited, Preston; car depôt, Mr. Edward Stephenson, Oldham; car depôt (steel work), Mr. John Mundy, Glasgow.

Paris—Versailles.—The new Paris—Versailles electric railway is now completely finished and the formal opening will take place on June 1st. There will be four intermediate stations on the new line.

Proposed Glasgow — Edinburgh Mono-Railway.—It is announced that Mr. Behr has been instructed to prepare plans for a railway on the mono-rail principle between Glasgow and Edinburgh, and a start has been made with the survey, preparatory to the promotion of a Bill in Parliament next session.

Richmond and Hampton Court.—The L.U.T. are employing large numbers of men in laying the track on this route, and the lines are down from Richmond Bridge to Twickenham and from Kingston Bridge to Hampton Court. Negotiations have still to be completed with the Teddington authorities before any work is done in the district.

Rochester.—The T.C. has decided to have a tramway system of its own, and is about to apply to the Light Railway Commissioners for an order. Plans have been prepared by the city surveyor (Mr. William Banks) which the Corporation has accepted.

The Chatham and District Tramways Company are making the last preparations preliminary to running their electric system of tramways. Hundreds of workmen have been employed in clearing out the grooves for the tram wheels. This has been rendered necessary because in many places the concrete has run into the iron grooves and has had to be "picked" out. The system as laid down in Chatham, Luton and New Brompton, is very comprehensive, and will prove a great boon to the combined districts.

Spain.—A mountain electric tramway has just been completed between San Sebastian and Monte Ulia.

South Shields.—A special meeting of the South Shields Town Council was held on the 15th inst. to consider *inter alia* the question of the promotion of a new Bill for a system of electric tramways in that borough. The scheme promoted by the British Electric Traction Co. for an electrical light railway from South Shields to Sunderland, having been thrown out by the Committee of the House of Lords, clears the way for the local authorities, for it was intended that the light railway should run right into the centre of the town, and in this fact lay the main cause of the opposition that the South Shields Council offered. The Tramways Committee recommended the Council to promote in the next session of Parliament a Bill to enable it to provide an adequate scheme of tramways for the borough, and that a Sub-Committee be appointed to settle route, gauge, system, &c. In the course of the discussion it was suggested that before they went to Parliament they should obtain tenders for running powers. Eventually the motion was carried. It may be mentioned that the British Electric Traction Company already have running powers, under another Act, over part of the trams, and are also lessees of the present system.

Sunderland. — The Tramways Committee of the Corporation at its last meeting decided to prepare specifications for the work of construction of the tramway extension at Pallion and to Fulwell, as well as the alteration of the existing lines at the corner of Tatham Street and Borough Road and in High Street West, and to ask for tenders for the work.

Surrey.—The County Council has arrived at a satisfactory understanding with the L.U.T., who undertake to widen High Street, Merton, and pay £100 per annum per mile of main road traversed.

Wallasey.—The final route of the new Wallasey Tramways was inspected by Colonel Von Donop, representing the Board of Trade, on Friday, and opened for traffic on Saturday last. The route lies from Seacombe to Newbrighton, *viâ* Liscard village and Sea Bank Road. This length completes the nine miles of track for which powers were obtained under the Wallasey Council Omnibus Bill.

Experiments have been carried out at Wallasey with a new life-guard, the invention of Mr. A. Royle, Sutton Oak, St. Helens. The guard is constructed on the gate principle, the edges of the hinged gate and of the "catcher" being covered with india-rubber, in order to minimise the risk of injury to a person with whom the guard may come in contact. The inventor claims that the guard will pick up obstacles, large or small, which may be on the track, and that a person would be carried safely on the guard until the car could be stopped.

ELECTROMOBILE NOTES.

Car Charging.—We understand that last week two of the cars taking part in the races, and belonging to the British Electromobile Company, were charged at the Tunbridge Wells electricity works on their way down to Bexhill. One of these cars was the winner of the "Electric Tourist Race." On the return journey a very fine car belonging to Mr. Roger Wallace, K.C., was charged. The arrangements for charging the cars were excellent, and as the town is midway between London and Bexhill, no doubt many electric cars will in the near future avail themselves of the accommodation provided.

Electric Mail Van.—On Tuesday morning the new electrical mail van, which was described and illustrated in our issue of May 9th, started its daily run from Mount Pleasant, its first load being a special delivery of mails to Waterloo. This is the first occasion that an English-built electrical motor van has been used for this purpose, and the postal authorities are giving the new system an extended trial in the City and West End services. Reliability is, of course, a most important factor, and the authorities and the contractors, Messrs. Julius Harvey & Co., of Queen Victoria Street, E.C., after considerable tests, have selected one of the Carl Oppermann's electric delivery vans made in Clerkenwell, the motive power being furnished by a set of "A B C" electric accumulators (Oppermann patent).

From the result of the trials already made, those interested are very sanguine of the ultimate success of this new system, and if their hopes are fulfilled, a large number of electrical mail vans will soon be running in London.

Motor Car Trials at Bexhill.—The energy and enterprise of the "The Automobile Club of Great Britain and Ireland," chairman, committee, secretary and officials, as well as many of the private members, calls for the highest commendation. At their own cost, and in conjunction with the Earl De La Warr, they have constructed a special course on the sea front of Bexhill solely for the trial of motor cars, a movement to foster the motor car industry in this country emulating similar motor car trial courses in France, at Acheres, and Vincennes, and in America, Germany and Belgium, which are known to have materially assisted the progress of the motor car industry in those countries.

On Whit Monday, the 19th inst., the Automobile Club held their inaugurative race meeting and exhibition runs of motor cars; all the best known motor cars of the world were there and ran in the contests. Most carefully prepared rules and regulations for the races and trials were arranged by the Races Committee of the club, amongst whom Mr. E. Manville, Mr. E. Hutton and Mr. Gorham were conspicuous, whilst the timing of the vehicles was in the hands of the referee, Lieut.-Col. R. E. Crompton, Mr. R. E. Phillips, who took the time with his electric timing apparatus, and Mr. Harry J. Swindley. The cars taking part in the trials and races were divided into classes, viz, tourist cars, motor cycles, light voiturettes, heavy cars, &c. Steam, petrol and electric cars were all represented. The course, despite the very inclement weather and heavy rain, was in capital order; it was completely enclosed by barriers, and was kept by the local police. Bexhill is now a charming seaside town, and there are good hotels with accommodation for motor cars. The example set by Bexhill will doubtless be followed by other fashionable resorts, and motor car courses will be set up in other parts of the country.

The course at Bexhill is a kilometre (1,098 yards) long between the starting and stopping posts; there is 160 yards down gradient, Galley Hill, about 1 in 12, to enable the cars to obtain a flying start before passing the starting post, and there is about 300 yards at the end of the course for pulling up after passing the stopping post. The course is most pleasantly arranged right on the sea front; it is nearly straight, and allows a good view from either side of nearly the whole length. It has a hard gravelled surface, plenty of room for two or three cars abreast, and is an almost ideal track; after the many races on Monday, and despite the rough weather, the track showed very few signs of wear.

Our chief interest, of course, was in the electric section. There was a race for electric tourist cars, entrance fee 1½ guineas. First prize, value £5 5s., was given by Messrs. S. Smith & Sons, 9, Strand, London, W.C. There were three entries, but only two turned up, viz.:—Mr. I. F. Ochs, with a Surrey (City and Suburban Company), weight of which, with batteries, was given as 1½ tons; and Mr. Theodore Chambers with a British Electromobile Company's car, weight given as 19 cwts. Mr. Ochs's car won this heat, doing the kilometre in 2 min. 1⅗ secs., equal to 18·5 miles per hour, but as Mr. Ochs had the best station, and got away first from the start, there was not much between the two cars. In the next race, Class E, for electric racing vehicles (entrance fee, 3 guineas) there were two vehicles only, viz, Mr. E. W. Hart, with a British Electromobile Co.'s car, and Mr. R. D. Wallace, K.C., chairman of the club, with a Krieger car. Mr. Wallace had Mr. Percy Northey and two other passengers, whilst Mr. Hart's car, with three passengers, viz., Mr. Henry F. Joel, Mr. Cockerton, the secretary of the British Electromobile Co., and Mr. W. D. G. Brown, their electrical engineer, was driven by Mr. Teal, and won easily in 1 min. 46 secs, or 21·1 miles per hour. The weight of this car was given by Mr. Chambers as 37 cwt. This, with four men aboard, would make 2·15 tons. The electric current taken at top speed was 120 amperes 90 volts, equal to 14·5 E.H.P.; this works out at 240 watt-hours per ton-mile. The batteries of 48 cells are equally divided over the front and back wheels, with two 3-H.P. electric motors driving the back wheels through toothed gearing. The general design of this car is on the now familiar lines of the petrol cars with a "bonnet" cover in front. It is a tourist car, and was not built on racing lines, the power absorbed by windage alone at the 21-mile speed being approximately 3 H.P., and this, of course, was against high speed; but the speed of the car was about the average speed attained in the Tourist Classes, with petrol and other cars, and compares favourably with them, whilst the perfect smoothness of running, starting and stopping, were admirable qualities which go far to make the ideal motor car, and which in themselves have justified the great interest and hard pioneer work given by the enthusiasts in solving the problem of a successful electric motor car. Speeds of 58 miles an hour (Jenatzy, in 1899), and 70 miles an hour (Laubat), have been attained with electric cars; it is simply a question of the power put on the car.

There was a very large gathering of the many notabilities of the club, and many thousands of interested spectators; the speed of some of the cars—54 miles an hour—was a source of great interest, and, indeed, astonishment to the ordinary sightseer, and the meeting was a great success. We hope it will be followed by other trials of motor cars, particularly of the electric cars, as so much is to be learned from them.

TELEGRAPH AND TELEPHONE NOTES.

Australian Cable Tariff.—The Eastern Extension, Australasia, and China Telegraph Company notifies that a tentative arrangement has been come to with the Federal Government of Australia by which the reduced tariffs now in force in the four contracting States—3s. per word for ordinary, 2s. for Government, and 1s. for Press telegrams—will be applied to the States of Victoria and Queensland pending the negotiations which the Prime Minister (Mr. Barton) proposes to conduct with the company's directors in London for a uniform agreement for the whole Commonwealth. The reduced rates will come into force on the first day of next month.

Cable Ship to the Rescue.—We understand that during the recent disasters at Martinique the cable ship *Pouyer Quertier* brought to Fort de France 436 persons, who were for the most part former residents of Prêcheur, and to whose rescue she had to pass through clouds of burning cinders. At another time she rescued 923 persons, and at the same time piloted the Danish cruiser *Valkyrien*, with 1,500 refugees on board. The *Pouyer Quertier* distributed among the sufferers large quantities of biscuits, milk, wine, cheese, and other provisions.

Fires.—The National Telephone Company's Exchange at Norwich narrowly escaped being destroyed on the 14th inst. by a fire, which broke out during the dinner hour in the fitters' shop in the upper storey of the Exchange building. By the prompt arrival of the fire brigade the damage was fortunately confined to the workshop. The company's District Exchange at Morrison Street, Glasgow, was completely destroyed on 20th inst., the damage being estimated at £2,500.

Grantham Telephones.—Sanction has been obtained to borrow £1,500 for a municipal telephone service.

Progress of the British Pacific Cable.—The following is an extract from an Australian paper:—

"Norfolk Island, *March 20th.*

"The steamer *Titus*, from Sydney, reached the anchorage at Anson's Bay at 7 a.m. on the 7th inst. She discharged some 400 tons of materials for the Cable Company, and sailed for the islands at 2 p.m. on the 17th. She was very fortunate in getting fine easterly weather during her stay, and great credit is due to the islanders for having boated and landed the cargo so quickly. She expects to reach here *en route* to Sydney on April 18th.

"The cable steamer *Anglia*, Captain Leach, reached Anson's Bay at daylight on Tuesday, 18th inst., and shortly afterwards made preparations for landing the cable. It was floated ashore attached to casks. A long hawser was first landed and made fast ashore, and the cable thus hauled ashore by steam power from the *Anglia*. At noon it was safely ashore and attached to the cable house. The *Anglia* then proceeded to sea some 12 miles, where she had cut and buoyed the cable connection with Southport, Brisbane. This was picked up and spliced, and we were then in communication with the wide world. The same evening the steamer reached the anchorage at Kingston, and yesterday discharged 80 tons of cable materials. This morning she proceeds to Anson's Bay to lay this end of the Fiji line. This will be paid out for about 30 miles, and will then be cut and buoyed. She will then lay the New Zealand section at Anson's Bay, and afterwards proceed with the laying of the cable across to New Zealand. This should be accomplished in a couple of days' time, so that by the end of this week we should be connected with New Zealand. Unfortunately when trying to land at Anson's Bay on the 18th inst., the ship's boat, with operators and instruments, was swamped in the breakers. The occupants got a soaking, as also did the instruments, but nobody was hurt and nothing lost. Nearly the whole of the island people assembled at Anson's Bay to see the cable brought ashore, and when it was fixed sang the National Anthem and gave three hearty cheers for his Majesty the King.

"Mr. Lucas, representing the cable company, and Mr. Bent, who will be the local manager here, assisted by a staff of operators, were engaged yesterday testing the cable. Everything was found in order, and messages have already been transmitted to London and Australia.

"The work of carting the material for the houses (five in number) is being rapidly carried out. A large staff of carpenters, &c., are at work, and very shortly the buildings will be up.

"Last night the *Anglia* gave a display of rockets, fireworks, &c. It was a grand sight.

"There is now employment for most people here, and things are very brisk."

Telegraphic Communication with the Continent.—In reply to a letter from the Association of Chambers of Commerce urging the establishment of additional and improved cables between the United Kingdom and the Continent, the following letter has been received from the Post Office:—"I am to assure the association that no effort is spared by this department to improve and accelerate the telegraphic service to and from the Continent by every means at its disposal. The association was informed on April 18th last year that an additional cable had just been laid to the Netherlands, and I am now to state that the proposed new cable to Germany has also been laid. These cables are of the latest type, and are so constructed as to yield the best attainable results in practical working. At the same time a direct wire has been opened between Liverpool and Paris. With reference to the cognate question of telephonic communication with the Continent, provision has been made for a direct telephone service between England and Belgium by means of a new cable which has been laid this month. As regards the Anglo-French telephone service, the negotiations for an extension of the service to provincial towns in both countries have recently been brought to a successful conclusion; and the Postmaster-General hopes to open this extension, so far as is practicable under existing conditions, as soon as the necessary arrangements can be carried out in co-operation with the French Administration. —I am, Sir, your obedient servant, J. C. Lamb."—*The Times.*

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899	
Alexandria-Larnaca	Jan. 19, 1902	
Puerto Plata-Martinique	May 5, 1902	
St. Lucia-Martinique	May 7, 1902	
St. Lucia-St. Vincent	May 7, 1902	
St. Lucia-Grenada	May 7, 1902	
Guadeloupe-Martinique	May 7, 1902	
Dominica-Martinique	May 5, 1902	
Landlines:—		
"*Via* Hanekin" on Persian territory	Feb. 24, 1900	
Communication with Baranquilla and Cartagena	Dec. 8, 1900	
Guanta-Barcelona	March 17, 1902	
Barcelona-Ciudad Bolivar	March 6, 1902	
Lougowaia-Khabarowsk	May 7, 1902	
Moulmein-Bangkok	May 15, 1902	

Telephones in Canada.—According to a Canadian contemporary, there are 55 telephone companies in the Dominion, of which 44 are at present in operation—25 in Quebec, 7 in Ontario, 6 in Nova Scotia, 5 in New Brunswick, 8 in British Columbia, 2 in the North-West Territories, and 1 in Prince Edward Island. The total telephone mileage for the Dominion is 113,294, of which 94,314 miles are controlled by the Bell Telephone Company.

Wireless Telegraphy.—France.—The Société Française des Telegraphes et Telephones Sans Fil has been authorised to instal on the coast of the Channel three wireless telegraph stations; one at Gris Nez, a second at Cape Antifer and a third at the Cape of the Hague. These posts will transmit signals a distance of 100 kilometres over the sea, and will accordingly be able to communicate with vessels coming within that radius, and fitted with the Branly system, of which the company is sole concessionnaire.

Belgium.—The Central Commission of the Belgium Chamber in its examination of the Budget of 1902 having (in view of the progress of other systems) questioned the advisability of the permanent adoption of the Marconi system for the wireless telegraphy installation of the packet boats of the State (which installation has been decided on), the Railways Department has intimated its intention of using the Marconi system on its various steamers, being convinced of its advantages, as a result of a three months' trial on the *Princess Clementine*. A sum of 156,400 fr. appears in the Budget for 1902, in this connection.

The schooner *Pleiades*, equipped with powerful Marconi plant, sailed from New York last week for her permanent station 300 miles east of Cape Cod. She is stationed directly in the path of Atlantic liners, and will report all vessels equipped with the Marconi plant.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barking.—June 6th. Motors, pipework, chequer plating, &c. See "Official Notices" May 9th.

Beckenham.—June 6th. The U.D.C. wants tenders for incandescent lamps. See "Official Notices" May 16th.

Brighton.—June 9th. Points, crossings, tie-bars, bolts, &c., for the Corporation tramways; also 300 tons of steel rails. See "Official Notices" May 9th.

Burton-on-Trent.—May 30th. Tenders for three 100-kw. tramway generators, switchboard, three Lancashire boilers, steam pipes, jet condensing plant, economiser, &c. See "Official Notices" May 16th.

Coventry.—May 26th. Steam and water pipes and accessories. See "Official Notices" May 9th.

Dudley.—June 6th. Tenders for the supply of incandescent lamps, and oil. See "Official Notices" May 16th.

Eastbourne.—June 6th. One dry-back marine type boiler and fittings. See "Official Notices" to-day.

Fulham.—June 5th. Tenders for pipework. See "Official Notices" to-day.

Glamorgan.—May 31st. Electric wiring, &c., for Parc Gwyllt and Angelton Asylums, near Bridgend. See "Official Notices" May 9th.

Glasgow.—June 7th. Economiser and condensing plants. See "Official Notices" May 9th.

Govan.—May 27th. Fuse boxes, meters, demand indicators, manhole and joint boxes, &c., for 12 months for the electricity department. See "Official Notices" May 9th.

Greenock.—June 2nd. Tenders for 300-KW. steam dynamo, with piping. See "Official Notices" to-day.

Hoylake and W. Kirby.—Tenders for electric lamps, oil, waste, &c., for 12 months. See "Official Notices" to-day.

Hungary. — September 1st. The authorities of Kolozsvár, in Hungary, want to introduce electricity for lighting and power purposes. See "Official Notices" May 9th.

Hunslet.—June 3rd. Tenders for two electric lifts. See "Official Notices" May 16th.

Launceston (TASMANIA).—September 15th. The Corporation wants tenders for polyphase generating, transmitting, transforming and distributing apparatus, reconstructing existing plant, enclosed arc lamps, &c. See "Official Notices" to-day.

L.C.C.—June 5th. Wiring and fittings for four fire stations at Battersea and Camberwell. See "Official Notices" to-day.

London, S.W.—July 31st. The War Office wants tenders for a self-propelled lorry (oil). See "Official Notices" April 25th.

Manchester.—May 30th. Erection of an electricity sub-station at Cheetham. Further particulars from the City Surveyor.

Poplar.—May 28th. Tenders wanted by the M.B.C. for special armoured cable. See "Official Notices" May 16th.

Poplar.—May 28th. Tenders wanted by the M.B.C. for 130 cast-iron arc lamp columns. See "Official Notices" May 16th.

Poplar.—May 28th. Wiring (conduit) and fittings at Union Offices. See "Official Notices" May 9th.

Roumania.—May 31st. Tenders are being invited until May 31st by the municipal authorities of Calarashi—Stirbeiu for the concession for the electric lighting of the town during a period of 35 years.

Russia.—The Ouprava Company, Saratoff, Russia, asks for offers for a central power station for the production of electrical energy for public and private lighting, traction and motive power purposes.

Stretford.—June 18th. Tenders wanted for boilers, superheaters and economisers, steam dynamos, condensers, pumps and mains. See "Official Notices" to-day.

Warrington. — June 2nd. Tenders for drivers' and conductors' uniforms. See "Official Notices" May 16th.

Worthing.—May 26th. Tenders wanted for one 250-KW. steam dynamo and one dry-back boiler. See "Official Notices" May 16th.

CLOSED.

Bournemouth and Poole.—Messrs. Browett, Lindley and Co. have received an order from the Bournemouth and Poole Electricity Supply Company for two 1,000-KW. steam alternators, complete with condensers and accessories. The engines are to be of the three-crank triple-expansion type, running at a speed of 250 r.p.m., and the alternators are to be made by Messrs. Ferranti, Limited, of Hollinwood.

Bromley.—The contract for replacing the storage battery at the Bromley Electricity Company's Works has been placed with Messrs. Pritchetts & Gold, Limited, Feltham, Middlesex.

Broughty Ferry.—The T.C. has accepted the following tenders for the electricity works:—Battery, the E.P.S. Co.; switchboard, Messrs. Lowdon Bros. & Co.

East Sussex.—A Committee of the C.C. has recommended the acceptance of the tender of Messrs. J. E. Spagnoletti and Co., amounting to £1,773 11s. 0d., for light and power plant, and £1,940 for the tramway plant.

Liverpool.—The Electric Lighting and Fittings Corporation, Limited, Duke Street, Liverpool, has received the order for the complete plant, including engine, dynamo, motors and lighting, for Messrs. Barker & Dobson's new works, Franklin Place, Liverpool.

Liverpool.—According to the *Liverpool Mercury*, the General Electric Co., of U.S.A., has contracted to supply three high-pressure steam alternators for one of the Corporation power stations at an approximate cost of 120,000 dollars.

Rotherham.—The T.C. has accepted the following tenders in connection with its scheme for electric tramways:—Rolling stock, Messrs. Dick, Kerr & Co., London, £8,711; overhead construction, Messrs. Macartney, McElroy & Co., London, £7,102; permanent way, Messrs. Macartney, McElroy & Co., London, £55,419. It was explained that as far as possible all the goods would be English made in connection with the rolling stock, and the only portion to come from abroad was the trucks, which would be of American make. Although there had been a lower tender the Tramways Committee had decided to place the contract with a British firm. The whole of the wheels will be supplied by a local firm, Messrs. Baker, and the crossings will be made at the works of Messrs. Hadfield, Sheffield.

Southend.—The T.C. has accepted the following tenders:—Norman Engineering Company, electric wiring; Herbert Morris & Bastert, Limited, crane, £135; R. W. Blackwell & Co., car lifting appliances, £35; Rawlinson & Sons, tower wagon, £60; B.T.H. Co., five feeder motors at £8 18s. each; D. King & Sons, 50 arc lamp columns at £8 10s. each; Crompton & Co., testing machines, £92 10s. The tender of Messrs. Crompton & Co., Ltd., for the supply of a motor-generator, balancer, two boosters, and two battery switches, at £1,995 7s., was accepted.

Suez.—The contract for the electric lighting has been awarded to Messrs. N. H. Beyts & Co., of Suez.

Swindon.—The tender of Messrs. W. T. Glover & Co., for the supply and laying down of feeder and distributing cables for the Corporation, amounting to £5411, has been accepted.

Willesden.—The D.C. has accepted the tender of the British Insulated Wire Co., Ltd., Prescot, Lancs., for the supply and erection of arc lamp columns, to be of the design and manufacture of Messrs. Rowland Carr & Co., 6 & 8, Lime Street Square, E.C.

FORTHCOMING EVENTS.

Thursday, May 29th.—At 8 p.m. Institution of Electrical Engineers (Dublin Section). Meeting at the Royal College of Science. Paper on "The Lighting and Driving of Textile Mills by Electricity," by Marshall Osborne. Immediately after the paper the annual general meeting will be held.

Friday, May 30th.—At 9 p.m. Royal Institution. Evening discourse will be delivered by G. Marconi, Esq., on "The Progress of Electric Space Telegraphy."

NOTES.

Institution of Electrical Engineers.—(BIRMINGHAM LOCAL SECTION.)—The officers for the session 1902-3 are as follows:—Past chairman: Oliver Lodge, D.Sc., F.R.S. Chairman: Henry Lea, M.Inst.C.E. Vice-chairman: J. C. Vaudrey, M.Inst.C.E. Committee: Fredk. Brown, Alfd. Coleman, Alfd. Dickinson, R. H. Housman, W. O. Rooper, W. E. Sumpner, D.Sc., A. M. Taylor, R. Threlfall, F.R.S. Hon secretary: D. K. Morris.

Belgian Society of Electricians.—At the monthly meeting of this Society, M. Halleux, professor at the Mons Mining School, gave an interesting lecture, with mathematical deductions, on the subject of Blondel's theory of coupling alternators. A demonstration of the application of electrical machines for the gearing of rudders of large steamers, intended to replace the present steam steering gear, followed. It was pointed out that the *Kronprinz Wilhelm*, the latest of the North German Lloyd fleet, afforded a series of examples of the latter-day application of electricity to lighting, heating, ventilation, refrigerators, winches, cranes, capstans, signals, telegraphs, safety apparatus, control and working of the doors of the air-tight compartments, fire alarms, steering gear, and, lastly, wireless telegraphy.

Personal.—Mr. David Shanks, of Messrs. Handley and Shanks, has gone to the United States in connection with the development of the firm's business.

A farewell gathering of principals, officials, and staff of the Birkenhead works of Messrs. G. F. Milnes & Co., Ltd., took place at Birkenhead on Tuesday evening of last week. Mr. G. F. Milnes presided, and, in the course of a short address, said that no one was more sorry than he, that owing to business reasons, his company had decided to close the Birkenhead works and concentrate their business at Hadley. He was sorry to part with the large number of their old employés who had stood by them for so many years in Birkenhead. A musical programme was then carried out. During an interval, Mr. Thomas Voss presented an illuminated address to Mr. Milnes on behalf of the officials and works' staff. An illuminated address was also presented to Mr. J. C. Milnes by Mr. P. J. Lawrence on behalf of the employés. On behalf of his son, Mr. G. F. Milnes thanked his old employés for their kindness in presenting the address.

Mr. F. L. Turner, of the Blackpool Corporation tramways, has been appointed general manager of the Yarmouth Corporation tramways.

GENERAL POST OFFICE.—Mr. A. J. Stubbs, first class technical officer, has been promoted to be superintending engineer of the North Metropolitan District, London, in succession to Mr. C. T. Fleetwood, retired.

Mr. G. Cheetham, assistant superintending engineer (provinces), has been promoted to be superintending engineer of the Northern District of Ireland in succession to Mr. J. Walby, deceased.

Electro-Magnetic Cannon. — The *Gazette*, of Voss, Germany, announces that experiments are being made at present at Berlin with an electro-magnetic cannon, invented by Prof. Birkeland, of Christiana. It appears that as a result of the experiments already made, a proposal has been received by a firm in Berlin for the purchase of the invention. The experiments are not, however, terminated. It remains to be proved that the electro-magnetic cannon can project a charge of two metric tons a distance of 20 kilometres. Prof. Birkeland says that his cannon will accomplish this feat. He affirms that to increase the flight of the projectile, it is merely necessary to increase the length of the barrel. With a barrel of 10 metres, he states, a projectile might be dispatched a distance of 150 kilometres, and with a barrel of 100 metres, it would carry 1,500 kilometres. The news is highly interesting, and we await the completion of this long cannon with eager anticipation. We cannot, however, refrain from mentioning the long bow of ancient fame in this connection.

Boilers for the Navy.—The Lords of the Admiralty have come to an important decision, the *Daily Telegraph* understands, regarding the boilers which shall be henceforth used in the Royal Navy. During recent years cylindrical boilers have been largely superseded by water-tube boilers—mainly those of the Belleville type—in British ships of war; but the Earl of Selborne and his colleagues have determined that in future our war vessels shall be fitted with a combination of boilers, one-fifth cylindrical and four-fifths water-tube. It is assumed that the combination of the two types will give the advantages of each—that the cylindrical boilers can be used when a vessel is cruising for a long distance at comparatively low power, while the water-tube boilers will be called into requisition when it becomes necessary to get up steam in a brief space of time, or when full power is needed in an emergency.

London Chamber of Arbitration.—We have received the following letter from Mr. Arthur Serena, chairman of the Joint Committee of Management of the above-named Chamber:—

"Guildhall, London, E.C.
"*May 20th*, 1902.

"London Chamber of Arbitration.

"Sir,—I venture to avail myself of the occasion of certain changes recently made in the rules of the London Chamber of Arbitration tending to simplify and expedite its procedure, in order to call the attention of the commercial public to its constitution and advantages in the hope that the classes for whose benefit it is designed, may avail themselves of it more generally than has hitherto been the case.

"The Court, as is well known, was established by the joint action of the Corporation of London and of the London Chamber of Commerce. Its president is one of his Majesty's counsel who sits either alone or with arbitrators selected by the litigants by preference from a list of some 1,200 gentlemen, many of whom are eminent members of the commercial community. Its sittings are held in the Guildhall. Its judgments have the validity of those of the High Court of Justice.

"Whilst no doubt there must always be cases in which a resort to the Courts of Law is essential, there are numerous others in the multifarious transactions of commercial life in which a speedy and friendly settlement by a Court, which is practically a Court of Conciliation, cannot be over-estimated.

"The effect of the alterations recently made in the rules and practice will, it is expected, result in the differences of litigants being settled, in the majority of cases, in the course of a very few days.

"I would desire to specially call the attention of residents in the provinces, and in foreign countries, to the facilities for the speedy and cheap settlement of contentious matters by resort to the Chamber of Arbitration, which embodies, in a great measure, the judicial functions of the Continental Chambers. Its value has already been recognised by several of those Chambers, and I would venture to suggest for their consideration, and that of commercial men generally, whether there are not many commercial contracts in which a provision might, with advantage, be inserted that differences arising should be referred to the London Court of Arbitration.

"Further information as to the procedure of the Chamber of Arbitration may be obtained from the Registrar at the offices, 5, Church Passage, Guildhall, or at the offices of the London Chamber of Commerce, 10, Eastcheap, E.C.

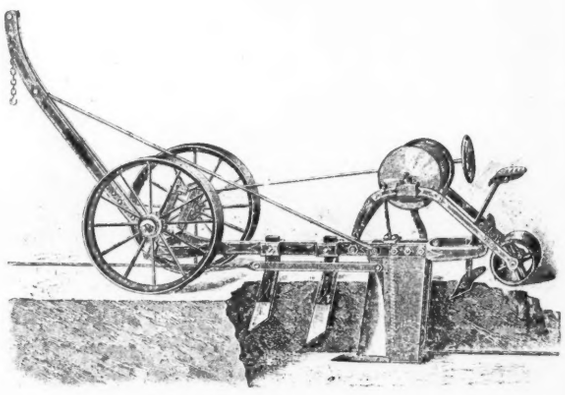
"I am, Sir, your obedient servant,
"Arthur Serena.
"*Chairman of the Joint Committee of Management.*"

The importance of this Institution to business men of all classes cannot be over-estimated. We have constantly advocated in our columns the insertion of a full and comprehensive arbitration clause in all contracts, and the Court provides an independent and convenient tribunal for the adjustment of the majority of differences arising out of commercial engagements, with economy of both time and money. We heartily commend the matter to our readers' attention.

A.I.E.E.—A New Reading.—Following Imperial precedent, the Institution of Electrical Engineers not long ago annexed—or, rather, shall we say, amalgamated with itself—sundry outlying and flourishing colonies of electrical engineers, and endowed them with autonomy under the ægis of its protection. There was, however, one colony which escaped its observation; its habitat is South Wales (the old, not the new), and its style is the "Amateur Institution of Electrical Engineers." Its membership is sufficiently indicated by its title—consisting of those quack "electricians" who have no claim to affix the letters A.I.E.E. to their names, but who are sufficiently devoid of moral principles to do so. We respectfully commend this colony to the attention of the Council of the Institution.

Municipal Electrical Association. — The seventh annual convention will be held in London on July 2nd, 3rd, 4th and 5th, 1902. The Westminster Palace Hotel, London, S.W., will be the headquarters of the council during the convention. Those requiring accommodation at headquarters or elsewhere must make their own arrangements, and are advised to reserve rooms at once. The large majority of members being in favour of a Smoking Concert in lieu of the usual Annual Dinner, arrangements are being made accordingly. Members wishing to introduce visitors to the convention must make early application to the secretary, Mr. C. McArthur Butler, St. James's Hall, Piccadilly, W., giving the names of those they propose to invite.

Plough for Laying Electric Cables.—The figure which we give herewith, reproduced from *l'Industrie Electrique*, shows an interesting labour-saving appliance which should be of use to power distribution companies in country districts. It is intended to deposit in the ground, at a depth of 28 to 32 in., without cutting a trench, cables suitably insulated for light, power, telegraph, and other purposes. The fore-carriage, method of regulating the depth, and steering system are the same as in the ploughs for heavy work made on the Bajac system. The working part consists of a strong coulter, which opens in the soil a vertical slot of the depth stated above; the coulter carries a conical share at its



lower end to give the necessary stability and cutting power; two smaller coulters begin the cutting in advance of the principal coulter. At the back of the latter are fixed two metal plates, between which is carried, low down and at the rear, a grooved guide pulley for laying the cable. This is rolled up on a reel held above the body of the plough by a suitable frame; as the plough advances the cable is unrolled and deposited at the bottom of the channel prepared by the conical ploughshare. A roller at the back of the apparatus smooths over the earth behind the plough, and also serves to regulate the depth of the cable beneath the surface. The whole system is carried in front on two wheels mounted on slides, which can be adjusted vertically independently of one another, and together with the back wheel determine the depth. It is interesting to note that this plough, which was constructed by M. Bajac, of Lioncourt, for the Société Française de Télégraphes et de Téléphones sans fil, is intended to lay the cable for the line across the Sahara, between Gabez and Lake Tchad. But why *sans fil?*

Appointments Vacant.—A shift engineer is wanted at the Sheffield tramway power station, to start at £120 per annum; an assistant is required for Oban at £100 per annum. See "Official Notices" to-day.

Crude Petroleum as Fuel.—The *American Electrician* describes a furnace and burner for crude oil, of which a test was recently made by Prof. Denton in New York. The boiler was of the return tube type, and had an ordinary grate. Except at the front, where provision was made for the admission of air, the grate was covered with firebricks, and upon its back half a checker work of firebrick was built. An air duct admitted air to the ashpit at the bridge. This air travelled under the grate to the front admission port. The fire-door and ashpit were otherwise closed, and a burner was placed to blow oil through the front and upon the checker work. The air ducts were four in number, and of 100 sq. in. area each. The boiler measured 6 ft. × 18 ft. Oil was pumped from a tank sunk in the floor and delivered to a standpipe in excess of the amount needed. The surplus overflowed at a constant level, and the oil pressure was therefore constant. Oil enters the burner at right angles to a jet of steam and hot air, which atomises the oil and spreads it over the brickwork, combustion being effected by the air flowing in by chimney draught at the front end of the grate. The evaporative effect varied on different tests from 15·29 to 15·71 lbs. of water from and at 212° per pound of oil. The burner consumed from 3 to 5 per cent. of the steam, so that the net effect

was from 14·74 to 15·16 lbs. of steam produced per pound of oil. The maximum chimney temperature is stated to have been only 425°. Combustion was practically perfect, and the boiler efficiency was 78 per cent. The grate surface was 45½ sq. ft., and there were 100 tubes 2½ in. diameter. Tests with coal also showed very good results, but the weight of coal burned was only 7·66 and 10·10 lbs. per square foot of grate per hour, a condition that always seems favourable to economy. It appears that to produce an equal power, coal at 12s. 6d. per ton (2,240 lbs.) is equal to crude oil at 3s. per barrel of 42 United States gallons. A United States gallon of water weighs only 8¼ lbs., and 4·23 barrels of oil are the equivalent of one ton of coal. The oil had a specific gravity of 920, a calorific capacity of 19,060 B.T.U. and a flash point of 142° F. It contained 84·6 per cent. of carbon, 10·90 of hydrogen, 1·63 of sulphur, and 2·87 of oxygen. There is an economy in labour because one man can attend to 30 burners, and there is, of course, the further economy as regards ashes and cleanliness. Trials made with the oil to try its danger or safety showed that a pool of oil spilled on a board would not ignite from a match laid on it. The match was extinguished and did not develop heat enough to vaporise the oil, but a pan 10 in. × 14 in., with a depth of 1 in. of oil, was set on fire in 40 seconds by means of a handful of kerosene-saturated waste laid blazing upon the surface of the oil. About 142° F. appeared to be the point of volatility. When a great excess of oil was suddenly admitted to the furnace the only result was to fill the furnace with black smoke. The air was in too small a volume to deal with the vapour, and there was no explosion. Crude oil at 3s. per barrel of about 36 English gallons, is hardly procurable in this country, we believe, in large quantity, but Mr. Holden, of the Great Eastern Railway, seems able to command various liquid fuels at a price to compete with coal, and liquid fuel offers the chance of raising steam in large quantities from ordinarily coal-fired boilers that should be useful in getting over the peaks of loads when these are of short duration. It is cheaper to burn costly fuel, perhaps wastefully, for a short time with assisted draught than to be burdened with the excess of plant and buildings necessary to run maximum load under ordinary draught with cheap fuel. Even where there is not available either liquid fuel or forced draught, the provision of a better coal or the use of even-sized nuts riddled out of the bulk of the coal will be effective in enabling plant to be kept within more moderate bounds.

THE CENTRAL STATION ENGINEER.

On Friday, May 16th, at the Croydon Electricity Works, a short but pleasing ceremony took place on the occasion of the departure of Mr. W. Jensen, the acting borough electrical engineer, to take up his new appointment as engineer and manager to the Chatham and District Light Railways Company. Mr. D. Cowan, the station superintendent, alluded to the good work Mr. Jensen had done at Croydon, and said that the employés and staff regretted the loss of a man who had been the backbone of the works. Mr. Jensen was then presented with a handsome gold watch chain, with an engraved medallion, and after a due response, the proceedings terminated with a most hearty send off.

NEW COMPANIES REGISTERED.

New British Arc Lamp Company, Limited (73,631).—This company was registered on May 5th, with a capital of £10,000 in £1 shares, to adopt an agreement with the Davy Electrical Construction Company, Limited, and generally to carry on the business of electricians, electrical engineers, mechanical engineers, producers and suppliers of electricity, manufacturers, and dealers in all plant, apparatus, lamps, cables, wires, accumulators and any other business which can be carried on in connection therewith. The first subscribers (each with one share) are:—H. D. Oppenheimer, 144, Sutherland Avenue, W., clerk; F. Mesheim, "Gaywood," Onslow Gardens, Wallington, Surrey, clerk; E. B. Pollard, 1, Bellasis Avenue, Streatham Hill, S.W., clerk; J. G. Mills, 161, Croydon Road, Anerley, S.E., secretary; E. Mieverholf, 20, Hart Street, W.C., merchant; E. W. Church, 51, Chesterfield Grove, East Dulwich, clerk; C. C. Smith, 18, Austin Friars, E.C., solicitor. No initial public issue. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first; remuneration as fixed by the company.

Rolled Steel Axle Box and Forge Company, Limited (75,096).—This company was registered in Edinburgh on May 14th, with a capital of £25,000 in £1 shares, to acquire the undertaking of "The Indestructible Rolled Steel Axle Box, Limited," and to carry on the business of engineers, contractors, iron and coal masters, steel manufacturers, electrical engineers and welders, wagon and carriage builders, wheel and axle makers, smiths, iron and brass founders, ordnance and steel manufacturers, tool makers, merchants, dealers, &c. The first subscribers (each with five shares) are:—J. G. Scott, 219, St. Vincent Street, Glasgow, contractor; N. Ure, 46, Maxwell Drive, Glasgow, merchant; W. C. Warden, 25, Gordon Street, Glasgow, merchant; G. Stirling, 154, St. Vincent Street, Glasgow, chartered accountant; J. Anderson, 175, West George Street, Glasgow, writer; J. Rankin, 154, St. Vincent Street, Glasgow, accountant; and J. Anderson, Wishaw, Lanarkshire, engineer. The number of directors is not to be less than three nor more than seven; the first are J. G. Scott, W. C. Warden, N. Ure, and J. Anderson; qualification, £200; remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Warrington and District Electric Light and Power Company, Limited (55,890).—This company's annual return was filed on April 5th, when 1,919 shares were taken up out of a nominal capital of £2,000 in 2,000 shares of £1 each. £1 per share has been called up on 1,869 shares, resulting in the receipt of £1,818. £51 remains in arrears. 50 shares are considered as fully paid. No mortgages or charges. Capital increased to £5,000 on April 26th, 1902.

Folkestone Electricity Supply Company, Limited (51,825).—This company's annual return was filed on April 15th, when the entire capital of £50,000 in 10,000 shares of £5 each had been taken up and paid for in full. Mortgages and charges £50,000.

Bromley (Kent) Electric Light and Power Company, Limited (54,127).—This company's annual return was filed on April 14th, when 3,561 shares were taken up out of a nominal capital of £50,000 in 10,000 shares of £5 each. £5 per share has been called up, resulting in the receipt of £17,797. £8 remains in arrears. Mortgages and charges, £20,000.

CITY NOTES.

Western Telegraph Company.

Sir J. Wolfe Barry, K.C.B., presided, in the unavoidable absence of Mr. W. S. Andrews (chairman) over the fifty-seventh ordinary general meeting of the shareholders of this company, held on Wednesday last week at River Plate House, Finsbury Circus. In moving the adoption of the report, the chairman said the accounts for the past half-year had not been altogether as satisfactory as they could have wished, as the message receipts amounted to £209,000, compared with £252,000 in the corresponding period of the previous year, showing a decrease of £43,000. But he must remind them that Mr. Andrews had told them last year that the receipts for the December half of 1900 were the largest the company had ever secured, principally due to the interrupted working of the competing lines, and the selection, in preference, of that company's route. During the period under review the company had also been working under a lower rate of tariff than in the half-year of 1900. But the more important fact affecting the business of the company, and all other companies like theirs, upon whose existence depended the general business of the world, was that it would be noticed the business of South America had fallen to a much smaller scale than in previous years. The Brazilian Exchange business remained practically the same as the previous half-year, whereas during the six months ended December, 1900, violent fluctuations occurred, causing a considerable number of telegrams to be sent between the principal cities in Brazil. The fact was that cable companies were mainly useful for conducting the commerce of the world, and their business felt, therefore, any slight depression which prevailed in the country served by them, and rose and fell according to the commercial state of things in the country. Although the comparison of the past half-year's working was rather adverse contrasted with the corresponding period of 1900, yet with that exception the comparison with every other half-year was satisfactory, and therefore there was nothing to discourage the shareholders in the accounts before them. The London expenditure showed a decrease of £1,470, and the expenses at the stations were less by £2,560. The cost of repairs and ship's expenses showed an increase of £8,949, which was owing to the fact that the company's repairing ship was in commission for the whole six months, as against four months in the previous half-year. Chartered steamers for repairs cost them £2,613 more, and additional cable was used to the amount of £3,511. The net result of the working expenses was an increase of £2,101. It should be remembered that the original cable laid along the cost of Brazil had for the last year or two kept their cable ship so constantly engaged in repairs that it had been decided to renew and in some parts divert the course of the cable at several positions where frequent interruptions occurred. The cost of the new cable which had been required appeared in the accounts. The operations had just been carried out by a chartered cable steamer, the expense of which would appear in the current half-year's accounts. The renewals had greatly improved these sections, and duplex working had been applied to one of the cables, a thing which was impracticable before. A large amount of the old cable had been recovered, and a considerable quantity was being brought home to be rendered serviceable for further use. The result of the half-year's working was that the usual first and second inter-dividends had been paid, £40,000 placed to the reserve fund, and £2,000 placed to the maintenance ship's reserve fund, leaving £5,531 to be carried forward, which he thought was not altogether an unsatisfactory state of things. They would remember that a dividend of 7 per cent. was paid for 1901, being the same rate as previous years, and £90,000 had been placed to reserve. Last January the board had created a further amount of £400,000 debenture stock, which ranked *pari passu* with the other stock of the company. Only £103,000 of the amount had been allotted, at a small premium, the balance to be issued as required. With regard to the subject of wireless telegraphy he had no reason to alter the opinion which he had formed, and which had been corroborated by others, that wireless telegraphy might prove a useful helpmate to cable companies, but he did not regard it as a serious competitor.

Mr. D. H. Goodsall seconded the motion, and the report was unanimously adopted.

Primitiva Gas and Electric Lighting Company.

The first annual general meeting of the above company was held on 13th inst. at the company's offices, Mr. H. E. Jones, the chairman, presiding.

In moving the adoption of the report, the CHAIRMAN, after dealing with the gas undertaking, remarked that the electrical plant had been largely reconstructed during the last two years, and the return was exceedingly satisfactory, showing an increase at the rate of 8 per cent. The report was adopted, and the auditors, Messrs. Touch and Co., were re elected.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending May 19th were £733; corresponding week last year, £710; increase, £23. Total to date, £12,810; corresponding period last year, £11,370; increase, £1,440. Miles of track open, 10¾.

Blackpool and Fleetwood Tramways.—The receipts for the week ending May 17th were £293; corresponding week last year, £413; decrease, £121. Total receipts to date, £4,870; corresponding period last year, £4,698; increase, £172.

Bristol Tramways and Carriage Company.—The receipts for the week ending May 17th were £4,352; corresponding period last year, £4,429; decrease, £77.

British Electric Traction Company.—The following returns are issued of the undertakings of this company for the week ending May 9th:—

Company.	Amount	Comparison with corresponding week of last year.		No. of weeks.	Aggregate.		
					Amount.	Inc. or Dec.	
	£	+ £	− £		£	+ £	− £
Devonport*	410	—	—	18½	7,130	—	—
Dudley—Stourbridge	684	27	—	18½	12,102	2,095	—
Gateshead‡	708	68	—	18½	11,872	68	—
Greenock-Pt. Glasgow	451	271	—	18½	7,487	4,222	—
Hartlepool	233	12	—	18½	3,664	281	—
Kidderminster ..	104	—	3	18½	1,830	146	—
Merthyr†	188	—	10	18½	3,520	—	474
Middleton*	252	—	—	6½	1,840	—	—
Oldham—Ashton ..	497	—	18	18½	8,726	15	—
Poole†	232	1	—	18½	3,850	38	—
Potteries	1,466	39	—	18½	25,531	1,045	—
Southport	236	100	—	18½	3,097	905	—
South Staffordshire†	757	4	—	18½	13,510	640	—
Swansea	438	£1	—	18½	7,636	723	—
Taunton*	52	—	—	18½	1,013	—	—
Tynemouth§	213	27	—	18½	3,693	230	—
Wolverhampton Dist.	143	91	—	18½	2,485	1,501	—

* Not in operation last year. † Partly steam. ‡ Comparison from April 5th only. § Comparison from March 18th only. ‡ Comparison from May 8th only.

Central London Railway.—The receipts for the week ending May 17th were £6,885; corresponding week last year, £6,399; increase, £486. Total receipts to date, £133,769; corresponding period last year, £123,957; increase, £9,832. Miles open, 6.

City and South London Railway.—The receipts for the week ending May 18th were £3,080; corresponding week last year, £1,909; increase, £1,171. Total receipts to date (20 weeks), £59,587; corresponding period last year, £39,767; increase, £19,820. Miles open, 6¼; last year, 4¾.

Dublin United Tramways Company.—The receipts for the week ending May 16th were as follows:—D.U.T. Co., £3,722 19s. 9d.; D.S.D. Co. £1,054 11s. 11d.; total, £4,777 11s. 8d.; corresponding week last year—D.U.T. Co., £3,776 19s. 6d.; D.S.D. Co., £912 10s. 10d.: total, £4,689 10s. 4d.; increase, £88 1s. 4d.; aggregate to date, £81,677 2s. 7d.; last year, £77,945 15s. 3d.; increase, £3,731 7s. 4d. Mileage worked, 46.

East Ham Tramways.—The receipts for week ending May 17th were £394 7s. 8d.; total to date, £17,001 10s. 11d. Started running June 22nd, 1901. Car miles run, 11,004. Number of cars, average 18.

Glasgow Corporation Tramways.—For week ending May 17th, £11,667 7s. 11d., compared with £11,441 5s. 1d. for same period in previous year.

Liverpool Overhead Railway.—The receipts for the week ending May 18th were £1,433; corresponding week last year, £1,644; decrease, £211. Total to date £28,090; corresponding period last year, £30,811; decrease, £2,721. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

WITH Consols and Kaffirs both strong upon peace reports, the Stock Exchange begins to present quite an animated appearance, and the probabilities of what will happen after the announcement of the ardently desired news are more eagerly canvassed than ever. But an impression gains ground that although the proclamation of peace might stimulate prices to some extent, a breaking off of negotiations could not do much eventual harm, inasmuch as the end of the war must necessarily be in sight, if only by the process of exhaustion of the enemy's troops. Accordingly the markets with which we have to deal are taking things easily, business, of course, being still unable to wholly throw off its holiday quietude. Next week, however, it is hoped that things will resume their normal degree of activity, to retain it until the Coronation festivities, at all events.

In the telegraph section the fluctuations in price are limited to a quartette. Eastern Preference has secured another 1 per cent. rise, which brings the quotation to about 87. At this the stock yields 1s. 3d. over 4 per cent, an excellent return considering the nature of the security and the difficulty which exists nowadays of obtaining a sound 4 per cent. investment. It is much easier to get a speculative 5 than a good 4 per cent. stock, and the demand is all for the latter. Eastern Extensions have regained the dividend and bonus taken from the price last week, but Eastern Telegraph Ordinary fails to score, and in response to the numerous inquiries for the reason of the difference in price between the mother company's stock and the child's shares, it can only be replied that "Chinas" are much better held than Eastern stock, and appear to be in stronger hands altogether. Submarine Cables Trust certificates are nominally 110 to 120, but dealing in them has come to be a matter of negotiation, and upon a seller declaring his hand, the price is promptly lowered. West African Telegraph shares are up £1 at 3. The West Indian group is quite unchanged, so that the effect of the disasters at Martinique and St. Vincent has been absolutely *nil* in the telegraph market. Globe Telegraph descriptions are steady, despite the flatness of Submarines. There is no recordable change in any of the telephone varieties.

City and South Londons maintain their hardy strength, and are again somewhat better on the week. Central Londons regarded the company's defeat in the Committee Room with resignation. Some members of the market declare in no uncertain terms their satisfaction at the loss of the Bill, saying that the company will do much better by strict attention to business, ventilation, and advertising opportunities on the existing line, than they were likely to do by entering a keenly competitive area. Waterloo and City stock remains at 92½; complaints are growing in connection with the poor accommodation and service provided by this company. It is appropriate to point out at such a time as this, when gilt-edged investments are so much to the front, that the electrical railway list offers several attractions on this field. They may be easily grasped by a glance at this table:—

Stock.	Price.	Yield per cent.
Central London 4 per cent. Debenture	117	£3 8 6
City & South London 4 per cent. Debenture ..	116	£3 9 0
" " 5 per cent. Preference (1891)	130	£3 17 0
" " " " (1901)	122	£4 2 0

Baker Street and Waterloo Company shares, after a brief spell of attention, are again lifeless at about 4½ discount. Great Northern and City Preferred "A" keep at 8½, and it is stated that a part of the line will be ready for traffic in less than a couple of months. Districts at 32¼ and Metropolitans at 80½ are a trifle lower since we last wrote.

Electrical supply shares are marking time, and again the hardest in the list are Metropolitans, which have gained another 10s. Buyers have to pay very little short of the top price quoted, and there are none too many floating shares in supply. Without venturing to forecast any definite move as the result of the Marylebone arbitrator's award, we may remark that, in a general way, the discounting beforehand of any expectedly good news is frequently attended with a fall in the price of the securities affected when the actual event takes place, however good may be its pronouncement. Metropolitans have had a very sharp rise during the past few weeks.

Brompton and Kensington Preference in relapsing 5s. display the only fall in the market, while the solitary rise is secured by Metropolitan 3½ per cent. Debenture stock, which is now exactly par. New Brompton Ordinary are 8½, and New Westminsters 3¾.

Callender's keep steady at 17½, the further interim dividend of 10s. per share just announced having no influence upon them, and Henley's are the same price. Telegraph Construction at 36, and Manufacturing at 10½ are also unaltered, the well-advertised departure of the former company's famous ship not arousing any inquiry for the shares. British Insulated Wire are 8½, and the 4½ per cent. Debenture stock looks buyable at its current quotation of 103½. In the traction section, North Metropolitan Trams are being largely dealt in by reason of the coming change in the company's system, and the price is fluctuating between 4¼ and 4⅜. British Electric Tractions can be sold at 13⅞, and the Preference at about 12½ or a shade more. Brisbane Electric Preference change hands occasionally at 4¾, and business in London United Preference (fully paid) was marked at 11 on Tuesday. The company's Debenture stock is harder at 106. New General Tractions at 2½, 3½ and 98 for the Ordinary, Preference and Debenture respectively, are the same as they were last week.

In a few days' time there will be offered a new issue of Preference shares by the Charing Cross and City Electric Lighting undertaking, and we understand that the Charing Cross and Strand take full financial responsibility. We also hear whispers of an electric concern from the spicy breezes which blow o'er Ceylon's isle, and investors will, perhaps, have an opportunity for discussing this coming Colombo Company next week.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME,	Stock or Share. ‡	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotations May 14th.	Closing Quotation May 21st.	Business done during week ended May 21st, 1902. Highest.	Lowest.
82,300	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	...	...	...	3½— 4½	3½— 4½	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	70 — 80	70 — 80	...	...
804,720	Anglo-American Telegraph	Stock	73/6	3½%	61s.	44 — 47	44 — 47	46	44
3,097,640	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	88 — 90	88 — 90	89	88½
3,097,640	Do. do. Deferred	Stock	£1 7s.	5s.%	2s.	7 — 7½	7 — 7½	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	5 %	...	3½— 4	3½— 4	3⅞	...
13,333,300$	Commercial Cable	$100	8 %	...	...	150 —160	150 —160	...	...
1,741,029£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	93 — 96	93 — 96	95¼	94
16,000	Cuba Telegraph	10	7 %	...	...	4 — 5 xd	4 — 5 xd	...	...
6,000	Do. 10 % Pref.	10	...	...	...	12½ — 13½xd	12½ — 13½xd	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	2½— 3½	2½— 3½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	8½— 9½	8½— 9½	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	99 —102	98 —102 %	...	...
60,710£	Direct United States Cable	20	3½%	3½%	...	9½— 10½	9½— 10½	...	...
101,300£	Direct West India Cable, 4½ % Reg. Deb., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	117 —127	117 —127	120½	118
1,930,807	Do. 3½ % Pref. Stock	100	...	...	...	84 — 87	85 — 88	87½	87
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	106 —110 xd	106 —110 xd	...	...
360,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	12 — 13	12½— 13½	13	12½
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	107 —112	107 —112	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	5½%	...	...	99 —102	99 —102	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	99 —102	99 —102 %	99	...
180,227	Globe Telegraph and Trust	10	5½%	5½%	...	8 — 9	8 — 9	...	...
180,042	Do. do. 6 % Pref.	10	...	...	...	12½— 13½	12½— 13½	12 15/16	...
150,000	Great Northern Telegraph, of Copenhagen	10	...	15 %	...	26 — 28	26 — 28	...	...
75,000	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —103	99 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	37 — 41 xd	37 — 41 xd	38½	...
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	...	...	...	100 —104	100 —104	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	2½%	...	...	¼— ⅛	¼— ⅛	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	5 %	...	..	⅝— 1	⅝— 1	...	...
983,333	National Telephone, Pref. Stock	100	5 %	5 %	5 %	95 — 99	95 — 99	...	...
200,000	Do Pref. shares	2	...	3⅛	3⅜	3⅛— 3⅜	3⅛— 3⅜	...	...
1,966,667	Do Def. Stock	100	...	60	64 xd	55 — 59	55 — 59	55	...
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅞— 5⅛	4⅞— 5⅛	...	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	94 — 97	94 — 97	95¾	94½
500,000£	Do. 4 % Deb. Stock Red.	100	...	4 %	4 %	103 —107	103 —107	104½	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	6 %	6 %	1 1/16— 1 1/16xd	1 1/16— 1 1/16xd	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	99 —102	99 —102	99¼	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,303	Submarine Cables Trust	Cert.	...	...	...	119 —125	110 —120	...	...
58,000	United River Plate Telephone	5	7 %	...	...	4½— 5	4½— 5	5	...
40,006	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4½— 5	4½— 5	...	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	103 —106	103 —106	..	...
155,600	West African Telegraph, 5 % Debs....	100	...	...	...	99 —102	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— ⅜	⅛— ⅜	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	99 —102	99 —102	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	11½— 12½	11½— 12½	12¼	11⅞
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	102 —105	102 —105	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	99 —102	99 —102	100½	100¼
88,321	West India and Panama Telegraph	10	⅝%	...	...	⅛— ⅜	⅛— ⅜	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	5½— 6	5½— 6	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	3½— 4½	3½— 4½	...	..
80,000£	Do do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	101 —104	101 —104	..	

ELECTRICITY SUPPLY COMPANIES.

100,000	Blackheath and Greenwich Dist. Electric Light, Ord. ...	1	...	...	...	⅛— ¼	⅛— ¼	...	...
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	...	...	...	100 —104	100 —104	...	...
19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	8 %	9 — 9½	9 — 9½	...	...
20,000	Do. do. 7 % Cum. Pref....	5	...	...	..	9 — 9½	8¾ — 9⅛	9⅛	9
50,000	Charing Cross and Strand Electricity Supply	5	9 %	9 %	10 %	9 — 10	9 — 10	9 9/16	...
50,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5½— 5⅝	5½— 5⅝	...	...
250,000	Do. do. do. 4% Deb. Stock Red.	100	...	...	...	105 —107	105 —107	105½	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	5½%	4 %	5 — 5½	5 — 5½	5⅝	...
150,000£	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	110 —113	110 —113	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	4 %	0 %	5 %	8 — 9	8 — 9	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12 — 13	12 — 13	...	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	123 —128	123 —128	...	...
200,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	...	...	...	103 —106	103 —106	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	4 %	4 %	4 %	8 — 9	8 — 9	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	12 — 13	12 — 13	...	...
400,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	107 —110	107 —110	110	109½
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	7 %	...	6½— 6⅝	6½— 6⅝	6 7/16	...
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	6 — 6½	6 — 6½	...	...
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	107 —110	107 —110	109	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	11%	12%	10%	10 — 11	10 — 11	10 1/16	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1½— 1⅝	1½— 1⅝	...	...
49,840	Do. do. do. 6 % Pref.	5	...	...	...	4 — 4½	4 — 4½	...	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	95 —100	95 —100	96½	...
98,769	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	6½%	16 — 17	16½— 17½	16⅞	16 13/16
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	111 —115	111 —115	..	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	97 —100	98 —101	...	...
8,652	Notting Hill Electric Lighting	10	7 %	7 %	6 %	14 — 15	14 — 15	14½	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½— 15½	14½— 15½	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½	...	...
150,000£	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	98 —101	98 —101	100	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	1⅞— 2⅛	1⅞— 2⅛	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	..	2⅜— 3⅛	2⅜— 3⅛	3⅛	...
109,518	Westminster Electric Supply, Ord.	5	13 %	10½ %	10½%	11 — 12	11 — 12	11 1/16	11½

* Subject to Founders Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
§ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation May 14th.	Closing Quotation May 21st.	Business done week ended May 21st, 1902. Highest	Lowest.
		†							
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	4½— 5½	4½— 5½	...	...
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	86 — 90	86 — 90	...	...
62,074	British Electric Traction	10	8 %	9 %	...	13½— 14½	13½— 14½	14	13⅝
90,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12¼— 12⅝	12¼— 12⅝	12 11/16	12⅝
600,000*l*	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	124 —127	124 —127	126	125
70,000	British Insulated Wire Ord.	5	20 %	15 %	10 %	8 — 9	8 — 9	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5½— 5⅝	5½— 5⅝	5 11/16	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	8 %	...	13s. to 15s.	13s. to 15s.	...	...
50,000	¶ „ „ „ 6 % Cum. Pref.	£1	...	6 %	...	16/6 to 17/0	16/6 to 17/0	...	...
105,731	Brush Elecl. Enging., Ord., 1 to 105,731	2	5½%	5 %	Nil	¾— 1¼	½— 1	¾	...
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	3 %	1½— 2	1½— 1⅝	1⅝	1½
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
125,000*l*	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	95 —100	97 —100	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	...	17 — 18	17 — 18	...	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	...	...
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	111 —115	111 —115	...	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	4 %	103 —106	103 —106	105⅛	104¾
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	4 %	103 —106	103 —106	105⅛	...
440,100	Do. do. Def. do.	Stock	...	...	4 %	100 —103	100 —103	...	...
855,000	City and South London Railway	Stock	1⅛%	1⅛%	2 %	72 — 74	73 — 75	75	72½
54,000	Crompton & Co., Nos. 1 to 54,000	3	7½%	8 %	...	3 — 3½	3 — 3½	3 1/16	...
100,000*l*	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	103 —108 %	103 —108 %	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	2½%	...	⅛— ⅜	⅛— ⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	2½%	...	2 — 3	2 — 3	...	...
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	75 — 80	75 — 80	...	...
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	82 — 87	82 — 87	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	1½— 1⅝	1½— 1⅝	...	...
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390... ...	2	...	...	...	2½— 3	2½— 3	...	...
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	97 —101	97 —101	...	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	...	...	9⅜— 10¼	9⅜— 10¼	...	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	98 — 101	98 —101	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	15 %	20 %	20 %	17 — 18	17 — 18	17 7/16	17
35,000	Do. do. do. 4½ % Pref.	5	4½%	4½%	...	5½— 6	5½— 6	5⅝	...
50,000*l*	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	111 —115	111 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	...	...
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	99 —102	99 —102	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3¾%	3¼%	1½%	4⅞— 5	4 13/16— 4 15/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5	...	...	10½— 11	10½— 11	...	...
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500	10	...	...	...	15½—16½	15½— 16½	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	6 %	...	19/0 to 20/0	... — ...	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	17½%	20 %	34 — 37	34 — 37	36¾	35½
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	... %	...	...	103 —106	103 —106	...	...
25,000	Telegraph Manufacturing, Ord. Nos. 1 to 25,000	5	12 %	12 %	...	10 — 11 xd	10 — 11 xd	10¾	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5½— 6	5½— 6	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	91 — 94	91 — 94	94	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 1/16—3/16.
National Electric Free Wiring, —1.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14½—15.
Do. do. Pref. (£10 pd.), 10⅜—10⅝.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (February 6th, 1902).

MARKET QUOTATIONS, Wednesday, May 21st.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	29/-	29/-	..
a „ Oxalic	per cwt.	82/-	82/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	42/-	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£83 10	£83 10	..
a „ „ ..	per ton	£80	£80	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£13	£13	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a „ (50/90%)..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£19	£19	..
a Lead, Nitrate	per ton	£24	£24	..
a „ White Sugar	per ton	£31	£31	..
a „ Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8d.	8d.	..
a „ Caustic (76/80%) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£95	£95	..
a Shellac	per cwt.	115/-	115/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 5	£6 5	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a „ Crystals	per ton	£8	£8	..
a „ Bichromate, casks ..	per lb.	2¼d.	2¼d.	..
METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£148	£148	..
b „ Wire, in ton lots	per ton	£224	£224	..
b „ Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£40 to £110	£75 to £125	..
c Brass (rolled metal 3" to 12") basis	per lb.	6¾d.	6¾d.	..
c Tube (brazed)	per lb.	8¼d.	8¼d.	..
c „ „ (solid drawn) ..	per lb.	7d.	7d.	..
c „ Wire, basis	per lb.	7d.	7d.	..
c Copper Tubes (brazed) ..	per lb.	8¾d.	8¾d.	..
c „ „ (solid drawn) ..	per lb.	9d.	9d.	..
g Copper Bars (best selected) ..	per ton	£69	£69	..

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£69	£69	..
g „ Rod	per ton	£69	£69	..
e „ Electrolytic) Bars ..	per ton	£63	£63	..
e „ „ Sheets ..	per ton	£75	£75	..
e „ „ Rod ..	per ton	£68	£68	..
e „ „ H.C. Wire	per lb.	8d.	8d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f „ Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	3/-	3/-	..
h India-rubber, Para fine	per lb.	3/1 to 3/1½	3/1 to 3/1½	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants) ..	per ton	49/1	48/6½	6½d. inc.
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	47/6 to 50/-	47/6 to 50/-	..
i „ Wire, galvanised No. 8 ..	per ton	£9 15	£9 15	..
g Lead, English Ingots	per ton	£11 15 to £11 17 6	£11 17 6 to £12	2s. 6d. dec.
g „ „ Sheet	per ton	£13	£13	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£8 15	£8 15	..
d Mica (in original cases), small ..	per lb.	3d. to 9d.	3d. to 9d.	..
d „ „ „ medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large ..	per lb.	3/8 to 7/8	3/8 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	11½d. to 1/2	11½d. to 1/2	..
p „ rolled bars & rods	per lb.	1/- to 1/8	1/- to 1/8	..
p „ „ strip & sheet	per lb.	From 1/2	From 1/2	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	9d. to 1/-	10d. to 1/-	1d. dec.
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15	to £40	..
i „ „ in bars		£58	£58	..
g Tin, block	per ton	£136 to £137	£135 to £136	£1 inc.
g „ foil	per lb.	1/6	1/6	..
n „ wire, Nos. 1 to 16	per lb.	1/9	1/9	..
p White Anti-friction Metals —				
"White Ant" brand	per ton	£36 to £60	£35 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7d.	7d.	..
j „ 6 lea. Flax	per lb.	5½d.	5½d.	..
j „ 3 ply 10 lbs. Russian ..	per lb.	4 15/16d.	5 15/16d.	..
j „ 10 lbs. Russian, single ..	per lb.	4½d.	4½d.	..
j „ 180 lbs. Jute rove	per ton	£10 2 6	£10 2 6	..
k Zinc, Sheets (Vieille Montagne brnd.)	per ton	£22 10	£22 10	..

Quotations supplied by: a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by: f India-Rubber, G.-P. and Teleg. Works g Messrs. James & Shakspeare. [Co., Ltd. h Messrs. Edward Till & Co. i Messrs. Bolling & Lowe. j Messrs. Walter H. Hindley & Co.

Quotations supplied by: k Messrs. Morris Ashby, Limited. m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Lt p The Phosphor Bronze Company, L

SOME NOTES ON ELECTRO-GALVANISING.

By SHERARD COWPER-COLES.

Electro-zincing has been extensively used in shipbuilding yards for coating steel plates and boiler tubes for the last seven years, and the results obtained have been highly satisfactory when the work has been electro-zinced under proper supervision, in a plant capable of fulfilling the conditions necessary to obtain an adhesive coating of zinc free from perforations. Electro-galvanised steel that has been exposed to the weather in a manufacturing district for over five years, shows little or no sign of deterioration; on the other hand, if the work had not been zinced in a proper manner, the coating obtained would have possessed no protective value, and signs of rust would have shown in a few months after exposure to the weather. Iron, when dipped in a bath of molten zinc, cannot have less than a given amount (about 1 oz. per square foot), the thickness of the coating depending upon the temperature of the zinc, and the rate at which the iron is withdrawn from the molten zinc. Work to be cold galvanised may be placed in the bath for an hour or more, and be withdrawn with practically no zinc on it, due to a bad electrical connection, or to the bath being too acid.

On numerous occasions work has been shown to the writer which has had a good appearance, but which when tested was found to be only coloured or flashed with zinc, due to a bad connection, or the bath being too acid, or the dynamo of too small a capacity for the size of the work under treatment. Work of this class is bringing the process of electro-galvanising into disfavour with many engineers; on the other hand, if the work is electro-galvanised under proper supervision, and in a plant which embodies all the conditions that have been found necessary to success, the results obtained are excellent, and for some classes of work are superior to hot galvanising.

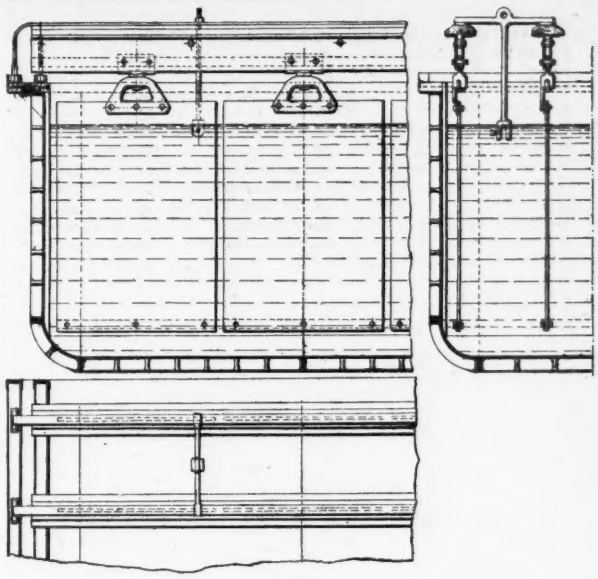


Fig. 2.

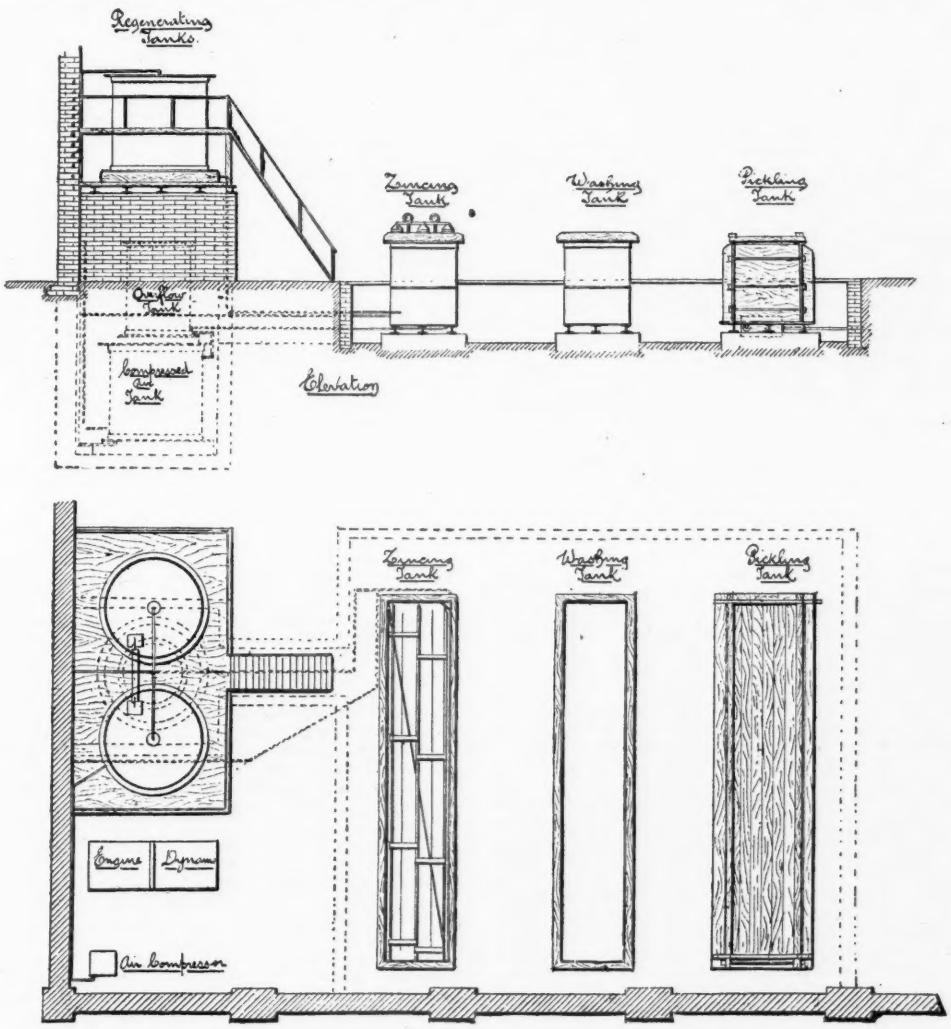


Fig. 1.

The Admiralty specifies that all boiler tubes should be coated externally with a coating of zinc equal to 1¼ oz. per sq. ft, and that economiser tubes should be coated inside and outside with an equal thickness.

The illustration, fig. 1, shows a plan and elevation of a Cowper-Coles regenerative electro-galvanising plant which has recently been erected for the Vulcan Shipbuilding and Engineering Company at Stettin, for the coating of boiler tubes for water-tube boilers, and general shipyard work.

The galvanising, pickling, and washing tanks are each 22 ft. long. The galvanising tank is provided with four sets of compound anode and cathode bars, as shown in fig. 2.

The dynamo, which is an eight-pole two-commutator machine is designed to give 3,000 amperes at 6 volts. The electric current is conveyed to the depositing tank by means of bare copper strips.

The switchboard is fitted with ammeter, voltmeter, and main switch; a shunt regulating resistance is also provided. An air-compressor is used for the circulation of the electrolyte, which is effected in the following manner:—The acid solution falls over a wooden sill placed in one corner of the zincing tank into an overflow tank, and then flows into the compressed-air tank; air is then blown into the compressed-air tank, and the solution forced up into the regenerating tanks. A non-return valve is placed in the pipe connecting the overflow tank with the compressed-air tank. The supply of air to the compressed-air tank is regulated by means of a three-way cock actuated by a float placed in the regenerating tank, in such a manner that when the air is cut off from the compressed-air tank it is blown through the solution in the zincing tank, thus keeping

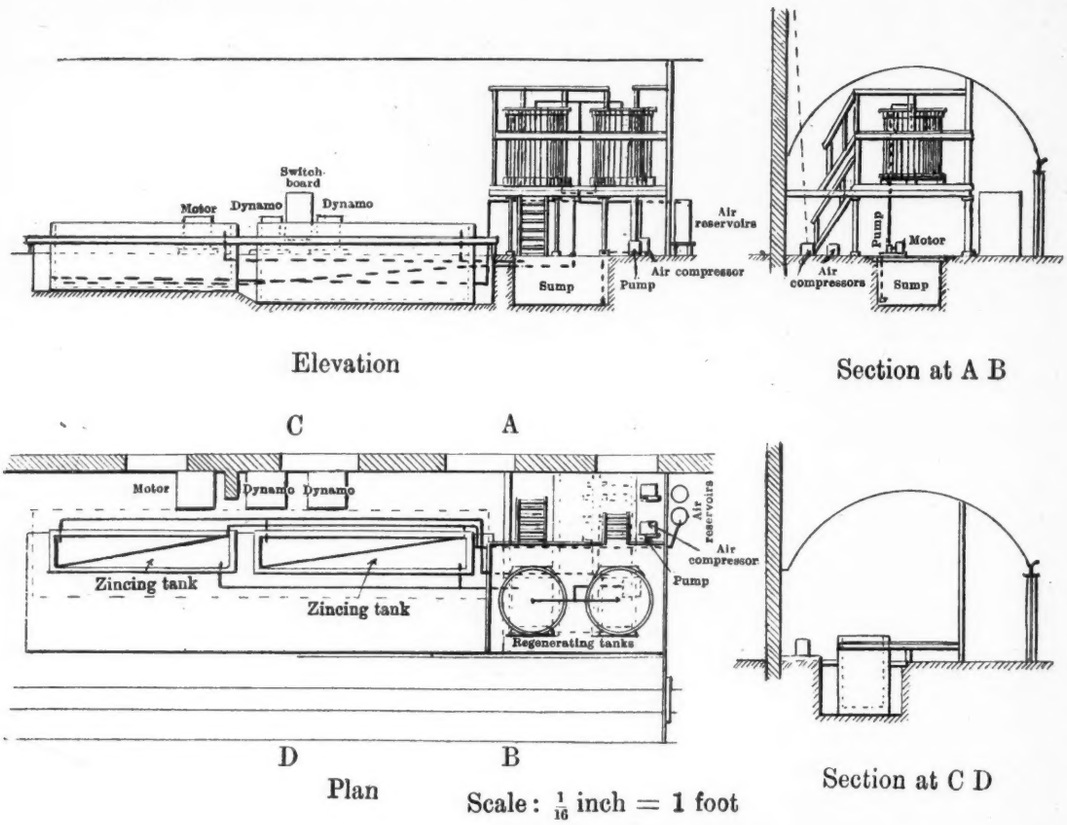


Fig. 3.

it agitated. Zinc dust mixed with small lumps of coke is placed in the regenerating tanks, on wooden grids covered with cocoanut matting, so as to form a filter-bed, and at the same time regenerate the electrolyte. The regenerated electrolyte returns to the zincing tank at the bottom at the corner opposite to that at which it leaves.

Fig. 3 shows a plant erected a few months ago for Messrs. John Cockerill & Co.'s shipbuilding yard at Hoboken, Antwerp. The electrolyte in this plant is circulated with a centrifugal pump instead of compressed air. The dynamo is a four-pole machine with two commutators, and the zincing tank is 19 ft. long, 6 ft. broad, and 4 ft. 6 in. deep.

The electrolyte contains 35 oz. of crystallised zinc sulphate to the gallon of water. In practice it is found very important to keep the zincing solution slightly acid, otherwise the zinc coating will not be adhesive, and will have a tendency to blister. The best proportion of free sulphuric acid is about $\frac{1}{10}$ oz. to every gallon of water. The amount of free acid in solution is quickly determined by using capsules of gelatine containing known quantities of alkali. A small portion of lacmoid solution is then added, and if a pink colour is obtained it indicates the presence of more than $\frac{1}{10}$ oz. per gallon of free acid. If a violet colour is obtained, the solution contains less than $\frac{1}{10}$ oz. of free acid per gallon.

THE CONTINENTAL ELECTRICAL ENGINEERING INDUSTRY.

The Nernst and Osmium Lamps.—A Teutonic Syndicate of Cable Makers.

It is not at all surprising, in view of the depression in the German electrical engineering industry, to find even companies of the first rank refraining from entering into certain classes of external contracts, notwithstanding that their foreign branches, agencies or connections render them or should cause them to be largely independent of the variation in the volume of trade in general, although not in the matter of prices. Among the contracts in question may be mentioned the equipment of a generating station at Lodz, and the construction of electric tramways at Warsaw and Lublin, all three of which have been declined by two Teutonic companies in Berlin and Frankfort respectively. As to the question of prices, these are still unsatisfactory, and it is feared that they will also prejudicially affect the companies in the current financial year.

The position of the Nernst lamp and the Osmium lamp is attracting a considerable amount of attention. With regard to the former, the German Patent Office a short time ago decided, in a claim brought by a Berlin chemist, that the Nernst patent No. 104,872 was invalid, but the owner of the patent—the Allgemeine Elektricitäts Gesellschaft—has declared that the decision is not of particular importance, seeing that it refers only to one of the 14 patents covering the construction of the lamp. Since then further complaints have been lodged against Prof. Nernst and the A.E.G. The patent attacked in the case of the professor related to the material used for the illuminating rod, but the Nullity Section of the Patent Office sustained the patent. In the case of the company, the complainant disputed the possibility of carrying out the electric heating apparatus, and the Patent Office has ordered a demonstration of the process, the result of which does not appear to have been announced as yet.

The Osmium electric lamp—the patent rights for which are held in the Fatherland by the German Incandescent Gas Light Company—is a considerable time in making its appearance on the market. In explanation of the delay the company recently stated that it was originally proposed to construct lamps for a pressure of 25 volts, because it is easier, for technical reasons, to manufacture such lamps than those of higher voltage. In the meantime the electric supply stations in Berlin, Hamburg and other large towns have proceeded to convert their distributing systems from 110 volts to 220 volts. It has therefore been in the interests of the company to construct lamps for higher pressures, and several months have already been devoted to the purpose of overcoming the difficulties in this direction. The company further remarked that the lamps would not be placed on the market until sufficient stock had been produced. This explanation in no way fulfils the anticipations set forth in the company's last report, wherein the hope was expressed that the manufacture of the lamp would be so far increased in the winter season that the current year's trading would show a profit from the sale of the lamps. At the beginning of April an Austrian paper made some uncomplimentary observations in regard to the lamp, which have produced another official statement. The company admits that the metal osmium is rare and dear, but the lamp requires little of it, and the filament after being in use for over

1,000 hours, can still serve as the raw material for new lamps. The osmium filament is superior to the carbon filament in regard to the duration of the illuminating power, although premature burning through also takes place in the case of the former. The company proceeds to state, apparently in contradiction to its earlier explanation, that the reason the lamp is not on sale lies solely in the fact that the lamps hitherto made are not equal in the matter of the durability of the filaments, but that some of them remained intact after being in use over 1,000 hours or 1,400 hours, whilst others were burned through in 500 hours or less. In these circumstances the company states that it is busily employed in testing methods for the production of lamps having uniform filaments. The outlook for the lamps, the patents for which were acquired from the Austrian Incandescent Gas Company by increasing the share capital of the German company to the extent of £33,350, does not appear to be very promising. The Austrian company, too, is entitled by the terms of the agreement to one-half of the future proceeds after it has received £25,000 out of the initial profits—certainly not an unsatisfactory bargain for that company. But the German company is now threatened with a competitor, seeing that a foreigner has made application to the Patent Office for protection for a new process of manufacturing an osmium lamp. The Incandescent Gas Light Company immediately submitted objections on the ground that the system proposed by the inventor was impracticable, but the Patent Office has overruled the objections, it being held that it is not impossible that something useful may result from the process.

An important announcement is contained in the report that a syndicate of cable makers has been formed, to which belong all the makers throughout Germany. The object of the organisation is to guarantee the individual members of the syndicate a definite annual turnover, but if it follows out the practice of other syndicates in the Fatherland—which seems highly probable in view of the unsatisfactory position of some of the works—it will have a more comprehensive scope. The policy of the syndicates in general is to combine for the purpose of forcing up prices at home in order to sell the surplus production in other countries at any price obtainable, even if the latter sales are effected at or below cost price. It is not very material to the syndicated firms whether their foreign transactions are conducted at a profit or at a loss, because if they are able to keep their works in constant operation they are able to produce more economically, and as any losses on export business are more than counterbalanced by the inflated inland prices—which are only possible by reason of the high protective tariffs in force—the final result is an average profit on the total output of a satisfactory character. On the other hand, the absence of syndicates keeps prices down, owing to competition among the home firms, and the general results are on the whole less favourable to the firms individually. If the new cable syndicate emulates its predecessors in other trades, we may expect further competition in England in the matter of cables. At the same time, it seems somewhat incredible that well-known and well-established cable makers in Germany should have become associated with some of the impoverished undertakings which have been founded during the past few years. It is doubtful whether they have; but the events of the next few months should throw some light on the question.

German Companies—Results.

The directors of the Company for Electrical Investments, of Cologne, which closed its financial year last June with a deficit exceeding £250,000 on a capital of £750,000, have been engaged for several months past in the elaboration of a scheme of reorganisation, in order to place the undertaking on a sound basis. Intimately associated with the Helios Company, for which it has acted as a trust, the company has now approved a scheme for reducing the share capital by one-half, namely, to £375,000, and for the issue of 6 per cent. preference shares to the extent of £250,000. The shareholders, by a large majority, adopted resolutions to this effect at an extraordinary meeting held recently, after amendments had been disposed of, which proposed the appointment of a committee of five members to ascertain the actual monetary requirements to reorganise the company, the actual amount of the deficit, and the extent to which a reduction in the share capital was necessary.

The Company for Electrical Enterprises, of Berlin, has experienced a severe set-back during the past year. It has a share capital which has remained stationary at £1,500,000 for several years past, and a bond issue which was increased from £1,500,000 in 1900 to £1,750,000 last year. The company, which acts as the trust of the Union Electricity Company, and the Loewe group, is interested in a considerable number of lighting, tramway, and other undertakings in Germany and other countries. The net profits realised in 1901 amount to £64,293, as compared with £143,743 in the preceding year, the former sum being less than in any period since 1896. As a consequence, a reduction in the dividend becomes necessary, the distribution proposed being at the rate of 4 per cent., as against 8 per cent. in 1900, 10 per cent. in 1899 and 1898, and 8½ per cent. in 1897 on the same amount of ordinary capital. In explanation of this retrogression, the report remarks that the economic depression has unfavourably affected a large number of the undertakings in which the company is interested. The receipts per car-mile from the numerous tramways remained practically stationary, and although the consumers of the electric lighting undertakings further increased, the expenses, especially wages, and the prices of coal, continued at their highest level. The condition of the Stock Exchange rendered it difficult to effect sales of securities, and compelled the company to write down investments, on account of depreciation, to the extent of £54,900. Among the securities disposed of at a profit during the year, the report refers to the sale of more than one-half of the number of shares held by the company in the British Thomson-Houston Company. The investments of the company are now booked at £2,867,500, as compared with £3,000,000 a year ago; but in view of the generally unfavourable position of affairs, new business is not being entertained.

The high stage of prosperity enjoyed for several years by Ludwig Loewe & Co., of Berlin, has been considerably checked by the results of the past year's trading, although the shareholders will still receive a handsome dividend for that period. It is pointed out in the company's report that special endeavours were rendered necessary in order to provide the factory with work, and that even where machine tools were actually required by customers, the latter postponed the placing of orders to a future occasion. Notwithstanding the inactivity in trade, the technical equipment of the works has been further improved. The company has disposed of its shares in the British Thomson-Houston Company at a profit, but the Aschersleben Engineering Works, and the German Niles Tool Works, in which the company is interested, suffered from a lack of orders. The gross profits for 1901 amount to £125,680 as compared with £171,733 in the previous year, and the net profits to £51,114 as against £99,033. It is intended to pay a dividend at the rate of 12 per cent. on the share capital, which amounts to £375,000, whilst the company has a bond issue of £450,000. The present distribution compares with a dividend of 24 per cent. paid last year, and in each of the financial periods since 1895.

The Heddernheim Copper Works Company has now carried through the scheme of reorganisation which was approved a year ago, and under which the share capital of £300,000 was reduced to £200,000, and an issue made of 6 per cent. preference shares amounting to £50,000. The income from manufacturing operations and investments was £25,323 less than in 1900, but, on the other hand, the general and working expenses, especially on account of the abandonment of the unremunerative St. Petersburg works in the previous year, were £69,678 less. It is proposed to pay out of the net profit of £1,826 the dividend on the preference shares for six months. There was no distribution made on the ordinary shares for 1900, but in 1899 a dividend of 5 per cent. was paid, in 1898 8 per cent., in 1897 9 per cent., and in 1896 8½ per cent. The company's report refers to the gradual transference of the departments from Heddernheim to Gustavsburg, and to the new installations at the latter place, and states that on their completion in July, the company will be able to manufacture advantageously. It appears that the heavy decline in the price of copper has not had any noteworthy influence on the undertaking, which has a sufficiency of orders for the present time.

The German Babcock and Wilcox Boiler Company, of Oberhausen, appears to make little progress. A loss of slightly over £100 was incurred in the year 1899—1900, and a net profit of less than that sum was earned in 1900—1901. The company has experienced the effects of the general depression, and notwithstanding an increase in the value of the orders from £12,500 to £64,000, the general results do not show any noteworthy improvement. The gross profits amounted to £15,479, and the net profit to £65.

Other Countries.

The Paris Compressed Air Company, which several years ago subordinated its compressed air branch to that of the supply of electric light, continues in an unsatisfactory condition. During the past financial year the gross profits amounted to £146,185, of which £5,267 was derived from the compressed air department, and the net profits reached £99,066, as against £81,200 in the preceding year. The net profits have as hitherto been transferred to the special account for the redemption of the capital expenditure, thus increasing this item to £235,334.

The Compagnie Générale de Traction, of Paris, which had a credit balance of nearly £48,000 at the close of 1900, has completed the past financial year with the enormous deficit of £800,000. After dealing with the unfortunate history of electric tramways in general, and the mistakes made by the company, the report states that a new combination has been formed whereby the necessary financial assistance has been assured, and the obligations of the subsidiary companies facilitated. The tramways in Paris and environs have been completed, and the works are in operation, so that the company will be able to devote itself entirely to the provincial undertakings. It is expected that satisfactory results will be obtained from these lines, although three years are necessary to obtain a normal working condition.

The condition of the Alioth Electricity Co., of Arlesheim, near Basle, regarded from the standpoint of the assurances given in previous reports, has created surprise among the shareholders of this Swiss undertaking. With a capital of £240,000, the year 1901 has terminated with a debit balance of £138,000, so that over one-half of the ordinary capital has been lost. The company's report attributes the considerable deficit mainly to the compensation paid for delays in delivery, the depreciation of raw materials and manufactures, and the abnormal height of the working expenses; in fact, the manufacturing and working expenses alone exceeded the income from the sale of manufactured goods. In the circumstances, the directors have proposed a scheme for reducing the share capital to £120,000 and issuing 6 per cent. preference shares to the amount of £120,000. When the scheme of reorganisation was submitted at the recent meeting an attempt was made to postpone the consideration of the report, in order that a committee might be appointed to consider the position of affairs. But on the chairman pointing out that unless the reorganisation was immediately taken in hand, it was possible the company would go into liquidation in the course of a few days, the amendment was rejected and the scheme was approved.

Among other Swiss enterprises may be mentioned the Neuhausen Aluminium Company, which proposes to pay a dividend for 1901 at the rate of 13 per cent., as compared with 12½ per cent. in 1900;

the Oerlikon Accumulator Works 15 per cent.; the Zurich Telephone Company 4 per cent., as in 1900; and the Société d'Enterprises Electriques, of Geneva, no dividend, as in the previous year.

The Hungarian Schuckert Company, of Buda-Pesth, is a new formation constituted by the Nuremberg Schuckert Company, the Austrian Lander Bank, Schoeller & Co., and the Bohemian Union Bank. It has a nominal capital of 2,000,000 kronen, and the basis of the company is the Pressburg works. The Austrian Schuckert Company—also a branch of the Nuremberg parent—has just decided to increase its share capital from 8,000,000 kronen to 9,000,000 kronen, in order to acquire shares in the Hungarian allied concern.

The Russian Siemens & Halske Company, of St. Petersburg, realised in the financial year 1900—1901 a net profit of 259,581 roubles as compared with 419,694 roubles in the previous year. This allows of the payment of a dividend at the rate of 2½ per cent. as against 5 per cent. in the corresponding period. The cause of the diminished profits is attributed by the company to the unfavourable Customs tariff for electrical manufactures and the unsatisfactory condition of business in general.

ELECTRIC TRACTION.

[Paper read at the Town Hall, Northampton, before the Tramways Committee and others.]

By PHILIP DAWSON.

(*Concluded from page* 834.)

Traction Systems.

If we neglect the method of working tramcars by means of accumulators carried on the car itself, which has been abandoned, there are three methods of operating an electric tramway, all similar in that current is generated at a central station and picked up by cars from a charged conductor. These systems of traction are known as:—

(*a*) The surface contact system.
(*b*) The underground conduit system.
(*c*) The overhead trolley system.

Of the above, the last two are really the only practical methods in existence.

(*a*) In the surface contact system, a number of contact studs are laid in the track, each stud containing a switch by means of which it can be connected to the feeders leading from the generating station. The switches are designed to be only operated when the car is over them, this being done by an automatic device of which there are several varieties—most of them are based upon the action of an electro-magnet. When the stud is not covered by the car, the connection between the stud and the feeder is broken, and the stud is dead and harmless. The car picks up the current from the stud by means of a slipper, which is made rather longer than the distance between the studs, so as to always make contact with one of them.

This system while perfectly correct theoretically cannot be said to have been a success commercially. In Paris a number of miles of track were equipped on this principle, but the system was found to be a complete failure; at present most of the lines in question are being converted to the overhead trolley system. There is only one example of the surface contact system in England, and that is the experimental line which has just been put in by the Lorain Steel Company at Wolverhampton.

The chief objections to the system are:—

1. There is always a possibility that one of the automatic switches may fail to act, with the result that a stud will be left energised after the car has passed.

2. The studs must project to a certain distance above the level of the road, or else the collector on the car will not make contact without rubbing on the road—hence the studs must always offer some obstruction to ordinary traffic.

3. There is considerable loss through leakage from the studs.

Practically the only thing that can be said in its favour is that it obviates the necessity of overhead wires, with their possible dangers, without the terrible expense which is entailed by the construction of an underground conduit.

(*b*) In the underground conduit or slot system a conduit is constructed under the whole length of track, which conduit contains the charged conductors from which the car collects current. Communication between the car and the interior of the conduit is established through a narrow slot in the roof of the latter, which permits the collector carried by the car to move along the conduit, and thereby make rubbing contact with the conductors. The conduit can be constructed with a separate slot rail in the centre of the track, or under one of the track rails, which combines the offices of slot rails and track rail. The objection to this latter method is the difficulty experienced at points and crossings. This difficulty can, however, be overcome by deflecting the conduit to the centre of the track when points or crossings are encountered.

The chief qualities required of a conduit are that it should have ample strength to resist any tendency of the slot to close, and that it should be easily cleaned out.

The chief objection to the conduit system is its very heavy first cost, and the amount of disturbance caused to ordinary traffic by excavations which are necessary when building it. In the case of the conduit of the Metropolitan Street Railway of New York, the cost of construction came out at about £30,000 per mile of track. With conduits special work is very expensive, not only in first cost but in repairs and maintenance, owing to the additional number of slot points and crossings.

The principal advantages of the system are:—

1. An insulated return can be used and the use of the track rails for this purpose dispensed with, thus avoiding bonding and any possibility of electrolysis.

2. It is not necessary to have overhead trolley wires, and thus any danger from their presence is done away with.

The system is a thoroughly sound one, and has operated with perfect success commercially in several cities in the United States and on the Continent.

(*c*) The overhead trolley system is the one which is almost universally used for tramways and light railways, and it is very doubtful if engineers would ever instal any other system, except under special circumstances. Where such has been the case, however, it will usually be found that the reason why the overhead system was not employed, was because the city authorities would not grant permission to erect overhead wires.

There are very few real objections which can be urged against this system. Many people object to the trolley wire on the ground of its appearance, but this is a matter which is generally remedied by use and familiarity; after a short time it is scarcely noticed.

It lacks one advantage of the conduit system, viz, the insulated return circuit, and special care in the bonding of the track is consequently necessary. Of course, it would be quite possible to have an insulated return circuit overhead, but the additional trouble and expense of stringing double trolley wires would completely swamp any slight advantage which might be gained therefrom.

The real objection to the overhead wire is that there is always a possibility, however slight, of its breakage and fall. This, however, is a most infrequent event, and there are numerous safety devices to prevent the possibility of any serious accident should such a thing happen.

On the other hand, the system has considerable advantages. It is much cheaper than conduit construction, and putting down the line does not cause nearly such disturbance in the streets. All the insulators, &c., are visible and accessible, thus facilitating and cheapening repairs and maintenance.

Electric traction is having a very great influence on the value of land, and considerable areas which before the advent of electric traction were a drug in the market are now being covered with houses. The reason of this is that the rapid transit facilities afforded by the use of electricity enable people to live at considerably greater distances from their work than formerly, and bring the outlying suburbs into much closer touch with the centre of business. It is in the expansion which is thus rendered possible that we may look for a solution to the ever-present "housing" problem.

Advantages of Electric Traction.—In the present state of affairs horse traction is quite inadequate to satisfactorily cope with the demands of a public who require to be carried quickly and cheaply from one place to another. Horses are slow and expensive and unsanitary, besides occupying a considerable amount of space, of which there is generally none too much. They can neither start nor stop quickly, but waste a considerable amount of time in doing either, especially the former. Thus, some form of mechanical traction is absolutely imperative, and of all forms of mechanical traction, electricity possesses the most advantages and desirable qualities. It is silent, clean, rapid and economical, and when starting from a standstill, full speed can be reached in a very short time. It is this quality of rapid acceleration which renders electric traction so specially suited for its work. It is only on comparatively rare occasions that a tramcar has a straight unimpeded run on which it can go at the maximum speed allowable—generally it is constantly being slowed up by the rest of the traffic. Thus on a crowded road a horse tramcar very rarely, if ever, runs at anywhere near its maximum speed, for by reason of the constant stops it never has time to get up speed before it has to slow down again. On the other hand, an electric tramcar being able to get up speed with extreme rapidity, can take advantage of every opening which presents itself, and maintain a very fair average speed under extremely difficult conditions.

At one time cable traction was considered a serious rival to electricity, but practical experience has proved the superiority of the latter system, except under most exceptional circumstances.

Where cable traction fails is in its rigidity—if by any cause traffic is stopped and the cars get "bunched" together, it is practically impossible to separate them again, as a cable car cannot make up time like an electric car. Another disadvantage is that it is quite possible for any gripman by making a mistake at points or crossings to practically wreck the whole system or anyhow throw it into confusion for some considerable period.

Every part of an electric tramway has received the most careful study by those who are interested in the subject, and at the present day there is absolutely nothing experimental about the whole subject. A very large amount of experience has been gained, and everything has been standardised, so that there need be no hesitation as to the results which will be obtained through the installation of the ordinary direct current system. One cannot urge too strongly the importance of using the best material in every branch of the system, and equipping the line in a thoroughly sound and solid manner.

The increased capital expenditure is more than counter-balanced by the smoothness of working of the whole system and the freedom

from accidents, breakdowns, and such like. The power plant especially should be most carefully designed, so that, in the event of extensions being required in the future, these can be made in a proper manner, so that the enlarged station will work economically and conveniently as a whole and not, as is sometimes the case, as two separate stations side by side.

In conclusion, a word as regards traction on main line railways may not be out of place. Until it may be satisfactorily proved that electric traction will reduce the working expenses, it is certain that no railway company will adopt it unless it is forced to. It is very doubtful if any of the high speed railways which are proposed to-day can be financially successful for long-distance travelling—it is expense rather than time which will be the determining factor. If railway companies can greatly increase their traffic by increased speed they can do so at once without adopting electric traction. Thus at the present moment the Pennsylvania Railway Company are running trains at a schedule speed of from 70—80 miles an hour for long distances with heavy trains. We are by no means near the limit of speed of locomotives in this country—thus at the present moment in France, the Northern Railway runs a distance of 184 miles in 3 hours and 10 minutes as compared to a distance of 183½ miles between London and Manchester run in 4 hours 10 minutes—capital is easily obtained when a profit is assured. Long-distance electric traction is no doubt a fascinating subject, but should not be at the present moment considered practical. We are unprepared at the present moment to undertake the electrification of main lines, and it has not been shown that it would pay if it were done.

Given all the schemes which have been so far suggested, there are such serious objections that it is not probable that anyone will be found hardy enough to carry them out. On urban and suburban lines the case is entirely different. There the traffic is ready-made, awaiting greater facilities which electricity alone can furnish. Here there is knowledge and experience to point the way in which the work should be carried out.

INSTITUTION OF ELECTRICAL ENGINEERS.

SOME NOTES ON POLYPHASE MACHINERY.

By A. C. Eborall.

(*Paper read at Manchester, March 25th*, 1902.)

(*Continued from page* 832.)

Construction of the Armature.

The mechanical construction of the armatures of large polyphase generators of the fly-wheel type turns very largely upon the question of rigidity, and the attainment of this at a minimum cost is by no means such a simple matter as appears at first sight.

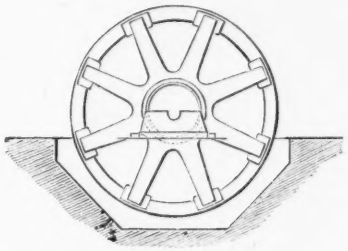
Even with slow speed direct current generators of large size, considerable attention has to be paid to the stiffness of the stationary part, and it is for this reason that most direct current generators of 2,000 to 3,000 kw. are built with cast-iron field yokes; otherwise this material would certainly not be employed, on account of magnetic reasons, and reasons connected with the cost of manufacturing, transport, erection, &c. Naturally, the case of the stationary armatures of large slow-speed polyphase generators is much more difficult; as already pointed out, the fly-wheel type of generator must of necessity be of large diameter in order that the necessary fly-wheel effect may be attained with minimum weight—it is essentially a machine of small width and large diameter. The armature, consisting of a cast-iron casing in which is assembled a large weight of laminated iron, is not in the most favourable condition for withstanding change of shape. For considering the complete armature, it is a built-up structure subjected to stresses, due to its own very considerable weight, to the magnetic pull, to the expansion and contraction caused by the changes of temperature of the core, and to the changing magnetic flux in the core. And yet perfect rigidity is a necessity in order to ensure security of working and freedom from vibration and noise. Clearly, in order that the air gap length may be limited to an amount which will not interfere with the efficiency of the generator (on account of the excitation losses) the most careful design and workmanship are required. An air gap of $\frac{3}{8}$ in. in a diameter of 25 ft. (4,000-kw. 50-cycle generator), worked at a flux-density of 58,000 lines per square inch, does not leave much margin for indifferent design or execution. As a matter of fact, the air-gap length (distance from iron to iron) in such generators is evaluated principally from this point of view, that is to say, from mechanical considerations.

The mere addition of weight to the armature casing does not necessarily mean rigidity, on account of the increase in the stresses on the structure due to such additional weight; the necessary stiffness must rather be attained by careful design, aided by special arrangements. Remembering also how greatly the magnetic pull on the armature increases with a decrease of distance, it is clear that it is of great importance to keep the air-gap of uniform length all round the armature; this means that the air-gap must be capable of being adjusted in all directions, when the generator is first erected, and preferably afterwards as well, so that the diminution in the air-gap length at the lower part of the armature, due to the wear of the bearings, may be compensated for, if desired. So that the special arrangements above mentioned for stiffening the armature must also include provision for adjusting it in every direction, in order to attain this object.

There are two principal methods used in the best practice of to-day, which may now be briefly described. The first method is well illustrated in fig. 3, and needs but little comment. The lower half of the casing is supported by adjustable screws all round it, so that the sagging of the lower half of the armature can be entirely prevented on account of most of the weight being taken on these screws. If the weight was not taken up in this way, the entire weight of the lower half of the armature falling upon the feet standing on the sole plates, it would be impossible, in a large machine, to prevent such sagging; the lower casing would be for the most part under tension under these circumstances, while, on the other hand, with the weight falling upon the foundation, the material is not subjected to appreciable stress.

With this method, the adjustment of the air-gap is readily made at any time; the magnet wheel being in position, the lower half of the casing is first erected on the sole-plates and then the air-gaps at the sides are made equal to one another with the aid of the horizontal sole-plate screws seen on each side of the generator. The upper part of the armature is now put on and bolted up, and then the whole armature is adjusted for equality of the air-gaps at the top and bottom by means of the vertical sole-plate screws. The three sets of supporting screws in the pit are next screwed out until the weight of the lower part of the armature is taken by them, after which the air-gap is once more checked all round, and a final fine adjustment of the screws is made if required.

Fig. 10a.



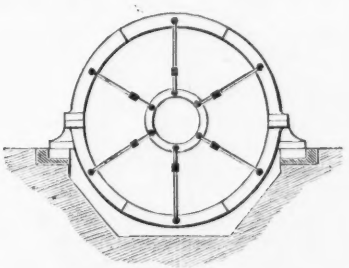


Fig. 10b.

In both portions of such an armature, the maximum stress on the casing occurs at an angle of about 45° to the horizontal; on account of this the upper part must have its greatest rigidity at these positions, but for the lower part this is unnecessary, on account of the casing being relieved of its stress by the screws.

The above method of arranging the armature makes a sound engineering job, leaving nothing to be desired; it has been used with the best results on a great number of machines of all sizes. The second method of armature construction referred to above is indicated in skeleton in fig. 10a; it originated with Messrs. Brown, Boveri & Co., and has been used by them since 1893 with great success. In recent years several other firms have adopted it or its modifications, one of which will be mentioned hereafter.

The method consists in carrying the armature ring on cast-iron spider frames, which are supported by trunnion rings cast on the main bearings; this special construction not only allows a very light armature casing to be used, as it is stiffened by the arms in a most ample manner equally all round, but it possesses other advantages. By removing a few bolts, the whole armature can be barred round on its centre, thus bringing the lower half out of the pit for inspection or repairs, and again, a bed-plate or sole-plate for carrying the armature is unnecessary; further, the armature bore, when the plant is first installed (new bearings), is absolutely concentric with the magnet wheel, and of course quite independent of the experience of the erector, as he cannot go wrong. The same excellent principle somewhat modified is employed in the armature construction of the external revolving field type of generator built by the same firm, which has already been described and illustrated in fig. 1.

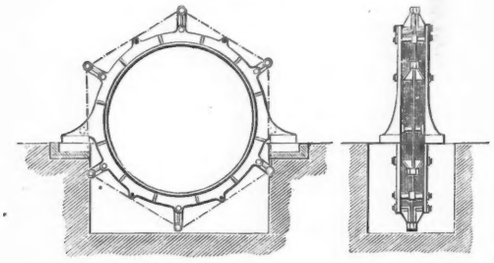
The disadvantages of the arrangement are trifling—should an armature coil situated immediately behind an arm of the spider frame burn out, it is somewhat difficult to get at it in order to rewind it, and also the machine is difficult to take down should this ever be necessary. To these two small disadvantages might be added a third, namely, that it is not possible to adjust the air gap to allow for wear on the bearings, but seeing that this wear is so

small in such plants, and as the armature is amply rigid enough to stand any extra strain that might arise owing to the gap at the bottom being a trifle smaller than that at the top, the point is of small importance.

An indifferent copy of the Brown construction is shown in skeleton in fig. 10B; it consists in substituting radial tie rods for the cast-iron spider frames. It is a poor design, on account of the unmechanical nature and unpleasing appearance of the whole construction, and also because the tie rods are subjected to vibrations communicated from the armature proper. It is, moreover, very doubtful whether the air gaps could be got properly right in generators constructed in this manner.

Another method of armature construction, which, however, is more or less in an experimental stage, is sketched in fig. 11, A and B; in this design the armature core is braced by means of adjustable tie rods arranged round the armature in either of the two ways shown. As can be seen, the core has no casing; it is built up in the shops

FIG. 11A.



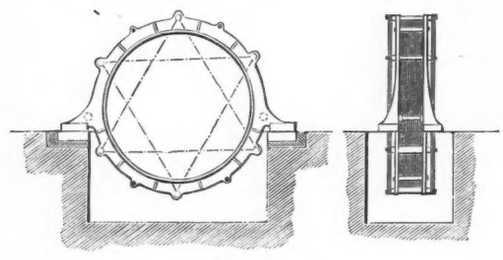


FIG. 11B.

between stout steel end plates and bored out; after erection the tie rods are adjusted until the bore is concentric with the magnet wheel. The construction represents an attempt to reduce the weight of idle material in the armature to zero, and also to standardise large machines, because as the armature casing does not exist, machines of varying output can be made by altering the width of the core; a generator constructed on these lines becomes exceedingly light and also cheap, and (because of the absence of the heavy armature castings) can be quickly manufactured. But in the author's opinion machines constructed on such lines afford an instance of theory pushed too far, for the construction, looked at from the standpoint of good mechanical engineering, is by no means above criticism. As the theory underlying the construction of such braced armatures is, however, of considerable interest, and apparently sound, it is perhaps worth while to point out very briefly the most important disadvantages of the arrangement.

The principal objection to be made, which is based upon the experience gained during recent years by the leading constructors of large polyphase generators, is that such a machine is bound to suffer from vibration. On account of the (already enumerated) stresses to which large polyphase generators of the fly-wheel type are subjected, a machine which has a definite inherent rigidity is certainly to be preferred to one made of a light bridge-work structure, such as a braced armature generator. The latter has no stiffness laterally, and is sure to vibrate sooner or later, especially when a really large machine is in question. If, for instance, owing to a slight inaccuracy in the adjustment of the tie rods, or to any other cause, such as temperature changes, the air-gap is a little smaller on one side than the other, a very large one-sided stress is produced, which on account of the elastic nature of the whole construction means vibration and noise. It is evident, therefore, that such braced armatures necessitate exceedingly accurate adjustment of parts, which must, moreover, be done when the machine is in position, the result being that the skill and reliability of the erector have to be entirely relied on, which is always undesirable. On the other hand, even if the air-gap was practically right all round, such a construction is very liable to be disturbed by resonance effects due to the combined vibrations.

The saving on the first cost of a generator having a braced armatures is not so much as would appear at first sight. In the first place, a well-constructed generator arranged on standard lines with a proper cast-iron casing for the armature core, has not a great deal of idle material about it, in proportion to the total weight of the machine. Thus, for instance, a three-phase generator of standard construction (compare fig. 2, and the data already given) rated at 4,000 KW., 75 revolutions, 6,500 volts, and 50 cycles, and having a fly-wheel effect $\left(\frac{1}{2} M v^2\right)$ of 10,700 foot-tons (cyclic irregularity when driven by a well-designed three-crank compound engine about 1 in 300) weighs about 190 tons without shaft, bearings, or exciter. Of this weight, about 32 tons is required for the cast-iron armature casing; the remainder must be reckoned as useful weight, as it is required for electrical and magnetic purposes, and to produce the fly-wheel effect necessary for the engine builder. So that the weight of idle material is only about 17 per cent. of the total weight of the generator, which is quite a representative figure for large generators, where the value is generally between 15—20 per cent. Bearing in mind that the armature casing consists simply of cast-iron, requiring less machining, and being cheaper to make than the tie rods and other appendages required for braced armature generators, it is clear that the total saving on the first cost of the latter (after allowing for carriage, &c.) is inconsiderable.

It is a mistake to suppose that the cast-iron casing of standard generators impairs the ventilation of the armature core and windings, for, as a matter of fact, the contrary is the case, provided this casing is well designed. Under these circumstances there will be a free and continuous circulation of cool air round and through the core and windings, and the effective radiating surface of the core is increased by the presence of the casing, so that the ventilation is always more than sufficient for the most stringent requirements. It is therefore evident that the armature without casing offers no advantage in this respect.

The unmechanical and light appearance presented by braced armature generators is not improved by the sheet-iron guards used for protecting the winding of the armature. As the core of the latter is quite open, the ends of the high pressure coils are wholly exposed at the sides of the armature, and are consequently dangerous and unprotected. In order to avoid this it is necessary to resort to protecting shields, which must be of sheet-iron if the design is to be consistent in omitting idle weight from the armature.

The disadvantages of the braced armature type of generator enumerated above will probably prevent its adoption in this country, where sound mechanical engineering is considered (and with right) to be the first requirement for all electrical machines. The question has been admirably summed up by Mr. C. E. L. Brown, who considers (in a recent communication to the author on the subject) that "the purpose of a cast-iron frame is not only to hold the core and to stiffen it, but also to centre it properly, to deaden the vibrations, to protect the windings during transport, erection, and also when in regular service, and lastly, to give the armature an attractive external appearance, so that it does not look like the works of a watch taken out of the case."

(To be continued.)

LIGHT RAILWAYS AND LAND DEVELOPMENT.

By J. M. HEWITT and W. G. RHODES, M.Sc., M.I.E.E., Consulting Engineers, Manchester.

(*Concluded from page* 840.)

Objects of the Light Railways.

Speaking generally, the object of the Belgian light railways is to supply a quick and ready means of transit for both goods and passengers from one village to another or from the surrounding country to the main line stations. There is no endeavour made to compete with the main railways; on the contrary, every effort is made to avoid competition. Where two towns are connected by both main line and light railway, the former takes the larger towns and the latter the villages on the route, and the fares for both goods and passengers are so arranged that between the two large towns there is a balance in favour of the main line. By this arrangement the support of the main lines is secured, and they welcome the light lines as local carriers for them.

The light railways have thus the effect of bringing the rural districts in touch with the main lines, and agricultural produce can quickly and cheaply be taken to the large towns for sale. There is, in fact, probably no country which is less dependent upon foreign countries for the necessities of life than Belgium, and which would feel less any foreign depression of trade. The reason of this is easily traced to the existence of their unique system of light railways, which stimulates the cultivation of the land, rendering the farming of formerly isolated districts not only a possible but a lucrative occupation.

As with agriculture, so with other branches of industry. In some parts of Belgium large areas of granite rock were

unworked owing to the great cost of cartage, but since the opening of the light lines quarries have been opened and have become staple industries of several districts.

The National Light Railway Authorities find that the effects of the construction of light railways have been :—

1. To make communication faster and cheaper between the country districts and the towns, to the great advantage of agriculture.
2. To foster trade and industry.
3. To abolish almost entirely cartage of bulky substance, which is always high.
4. To cause a fall in the price of all articles of consumption brought into the district.
5. To stimulate new industries, and provide more employment for workmen.
6. To render substances valuable which were previously worthless, by making it possible to work them.
7. To save the Government considerable sums of money by doing away with many mail coaches, the mails being conveyed gratis by the light lines.
8. To reduce the cost of maintaining high roads.
9. To increase the receipts of main lines.

The National Light Railway Company of Belgium.

Let us now inquire how it has been possible to provide Belgium with so complete a network of light railways, and to run them through districts for the purpose of developing them where the traffic had to be created. Obviously private enterprise would not construct a line through a district which would require a few years to develop into a paying concern. This being the case, and realising the great importance of opening out the rural districts, even at the risk of temporary loss, the Belgian Government gave every encouragement for the formation of the National Light Railway Company. Such a company had for years been talked about, but it was not until 1885 that it became an accomplished fact.

On the formation of the National Light Railway Company the National Treasury advanced the sum of £40,000 to cover preliminary expenses, and also guaranteed to contribute annually, if necessary, a sum not exceeding £24,000 to assist in paying the interest on the bonds issued by the company. The State agreed to still further assist by taking up a limited number of shares in any light railway exploited by the company.

This support on the part of the State made it a comparatively easy matter for the company to borrow money at 3 per cent., for which they issued bonds.

If a district desires a light railway, the local authorities apply to the directors of the National Light Railway Company to construct one. The company then proceeds to examine the district through which the line would run, and to form an estimate of the capital outlay necessary to complete the construction. If, after having done this, the directors consider the scheme sufficiently promising, the province and locality through which the line will pass have to guarantee not less than 50 per cent. of the money required. The actual payment of the money may be spread over a long term of years. Private individuals may, if they desire, contribute, but they have to pay in full at once. The State then makes up the deficit.

The capital necessary for the construction being then guaranteed, the directors of the Light Railway Company borrow the money on 3 per cent. bonds on the whole of the undertakings.

The actual working of the line until the province and district have paid their last instalment, when the line becomes their property, is let by public tender, preference being given to local contractors, or to public authorities, who are required to run a minimum service of trains which may be increased according to the requirements of the traffic. Beyond a certain minimum payment, the contractor is paid a pre-arranged percentage of the receipts.

In this way the National Light Railway Company is able to construct lines through districts which, while not promising immediate profitable returns, show indications of developing into paying undertakings, the result being that new districts are opened up, and fresh industries created and developed to the benefit of the district in particular, and the country in general.

What can be Done in England.

What has been done on the Continent through this system for the benefit of agriculture, can be done here with similarly beneficial results; hundreds of acres of land in this country are at present lying fallow because of the impossibility of realising a profit on the cultivation, although we import dairy produce alone to the extent of 30 millions per annum.

Light railways, by themselves, may not produce the best possible results, but in combination with the factory system of associated farming, which, first in America, and subsequently on the Contiment, has proved so successful, there is no reason why a large portion of the land at present out of cultivation should not help to reduce the imports by a considerable amount.

Light railways, on which electricity is the motive power, would give considerable advantage to English agriculture over the older system on the Continent, where steam is the general motive power, as the electrical generating station might also comprise the factory where the milk from the associated farms could either be sterilised, or made into butter and cheese, and the cost of running the machinery could be reduced, by employing the men who run the generating station also to look after the machinery necessary for the treatment of the milk.

The associated farms could then have power at a cheap rate for thrashing, cutting, grinding, or for any other purpose required, as well as the electric light which is at present looked upon as a luxury.

Attention has already been drawn to the fact that the Light Railways Act of 1896 was passed with the intention of promoting the interests of agricultural and fishing industries in this country.

With this object in view, the Government offered to advance free grants of money, or loans, on certain conditions to an extent not exceeding one half the total cost of construction of the lines. The conditions attached to these loans are, however, such as would not conduce to the successful working of the lines, and could seldom be realised in this country.

The first condition is that a railway company already in existence shall construct and work the light railway, and a second is that landowners, local authorities, and other persons locally interested, shall by free grants of land or otherwise give all reasonable assistance and facilities in their power for the construction of the railway.

It is, of course, highly essential that the approval and, if possible, the support of the existing main lines of railway be secured, but it is neither to their interest, nor to the interest of the light railways, that they should construct and work them. The methods of working in the two cases are entirely different, and it is highly improbable that both could flourish under the same management.

The light railway has a field of its own, with special aims and conditions, which can only be fostered by special methods and by people specially interested in, and adapted to, that particular class of work. These aims and conditions are not only not antagonistic to main line enterprise, but, on the contrary, are such as to promote the interests of, and increase the traffic on, the main lines. It is only necessary to convince the main line authorities of this fact and their approval and support are gained. This is amply demonstrated in Belgium with the best results.

In the second place, State aid for the establishment of light lines should not be conditional on landowners giving free grants of land. These conditions leave the controlling influence in the hands of the landowners, who form but a small proportion of the population. The desires of the local authorities and the requirements of the people, which should be the only *sine quâ non* in order to obtain State aid, may be frustrated by people who happen to own the land.

If landowners do not endeavour to carry out the reforms themselves, or to associate with others for the benefit of the people who rent their land, it should be possible to act without their assistance or consent.

To illustrate the effect of the Light Railways Act as it at present exists, there is one case in which last year the Light Railway Commissioners recommended the Board of Trade to authorise the construction of a light line about 12 miles in length where the conditions are exactly those to which the

Act was intended to apply. A Treasury grant will also be forthcoming providing the necessary conditions are satisfied. The local authorities are not only anxious to have the line, but are willing to advance a considerable sum for its construction. Some of the smaller landowners are also willing to render all the assistance in their power, but the large landowners will not give any land for the purpose, nor will they sell at agricultural value. Thus a district of about 120 square miles is still without a railway; the inhabitants continue to pay six shillings a ton for cartage of coal and other necessaries, the fishermen are often obliged to sell their fish for manure instead of food, and cattle have to be taken long distances for transport to a market.

The district is an ideal one for a light railway, the land being fertile and rich in minerals, but the action of the landowners is keeping it from contributing as it should do towards the national welfare.

The cost of completely equipping a narrow-gauge line for 12 miles through this district, including generating station, would be about £50,000, and if it is considered to serve a mile of land on each side of the railway, the 24 square miles served being equal to 15,360 acres, the cost of the line would be about £3 6s. 6d. per acre, or slightly less than 2s. 4d. per acre per annum, allowing 3½ per cent. interest. This is a very small amount when it is considered that in America agricultural land has under similar conditions increased in value from 5s. to £10 and £20 per acre.

No farmer would object to pay this amount for the extra facilities given, and if the landowners would pay one-third of the increased values which would be obtained from the land to a company to induce them to construct a line, and one-third to the local authorities, there would be very few districts without a light railway, since then the light railway companies would have a direct interest in the land being developed in the best possible way, and landowners, shareholders, and local authorities would have a common interest in the development of the district.

If we have to wait for landowners it will be impossible to make great progress; commercial men must be induced to enter the field, with all the help the Government can give them; the conditions of labour and earnings will then be so assimilated to those in the towns, that agricultural employment will be sought after, and the country will benefit by the removal of a large proportion of the town population into healthier and better surroundings.

There is a 30 millions per annum trade to work at, with sufficient land for the purpose, and all that is required is the necessary enterprise in order to produce results equal to those of a good manufacturing business.

ELECTRICAL LEGISLATION AND THE INST. E. E.

(*Continued from page* 838.)

FEW men are better able to instruct the public upon this question than Lieut.-Colonel Crompton, whose evidence is of especial value. As one of the pioneers of the industry, a manufacturer and contractor, he experienced all the difficulties arising from the legislative restrictions and obstructions by local authorities, of which such well-deserved complaints are made.

In his statement to the Committee, he speaks from his personal experience as a designer, consultant and manufacturer, the history of his own firm being representative of the general experience of England's electrical engineering. He points out the rapidity with which progress was made in this country between 1878, when he started, and 1882, when the first Electric Lighting Act came into being. No country was in advance of us, on the contrary, the most important schemes for town lighting from large central stations were prepared, companies were formed, capital provided, and although there was much speculative inflation and too sanguine ideas afloat as to the possibilities and probabilities of electricity supply in the immediate future, they did not warrant the handicapping of the industry by such stringent conditions as were imposed under the Act.

No doubt the over-speculation and the restrictive legislation taken together, dried up the flowing tide upon which electrical engineering was starting with so fair a prospect; but as Lieut.-Colonel Crompton states, there was no practical reason (but for these exceptional reasons) why London should not have been supplied by the end of 1884.

The advantages enjoyed by America, Germany and Switzerland in being encouraged, instead of restricted, by legislative enactments and regulations, enabled them to forge ahead of us, being able by the use of bare overhead copper wires to develop and experiment on the whole arrangements of electrical network, whereas the restrictions which necessitated underground conductors with heavy capital expenditure, rendered such facilities in our country impossible. And so, as Lieut.-Colonel Crompton describes in his most interesting statement, we gave our foreign competitors a six years' start of us.

The creation of the consulting electrical engineer is a natural outcome of municipal trading, as the town councillor knows nothing of the business upon which he so airily embarks with the ratepayers' money; and Lieut.-Colonel Crompton compares this with the practice in other countries where electrical enterprises are carried out by the manufacturing engineer's own staff, who are able to design and work out the details of complete projects. The same system, of course, applies in the case of private company enterprises, the work not only being better done but a saving of 5 per cent. secured on the capital outlay, which is a matter of considerable importance—the commission actually paid in one of the metropolitan boroughs being sufficient to put down an installation for the supply of a small town.

Lieut.-Col. Crompton's remarks upon the effect of municipal monopolies in electricity supply upon the congestion of population are very much to the point. He says: "The tendency to municipalise all these enterprises has led rather towards concentration in towns, and is against distribution of the manufacturing population over rural districts. Towns naturally wish to increase the value of their rateable area as much as possible; the decentralising by electric transmission is opposed to this."

Lieut.-Col. Crompton recommends as a remedy for the evils complained of that the Institution should show a united front—that they should invite the Board of Trade and Parliament to consult them in matters of technical and legislative procedure, following upon the Swiss system. The difficulty appears to us to lie in securing the "united front," so long as a section of their members are so deeply interested in fomenting municipal trading.

Under the examination of Mr. Kingsbury, Lieut.-Col. Crompton expressed some strong opinions upon the municipal consulting engineer fraternity when he said, "It was a matter of common knowledge that a very large number of junior and ill-educated men are acting as consulting engineers, and doing our industry a great deal of harm. Men who left us as pupils, and who were failures in everything, blossom out into consulting engineers, and gradually have a large number of towns to do. This is a scandal which everybody admits, and yet it cannot be avoided so long as those towns must employ their own consulting engineers."

Some interesting evidence was brought out by Mr. Campbell Swinton, showing the difficult problems connected with municipal trading. The labour question was emphasised by the conversation between Mr. Madgen and Lieut.-Colonel Crompton, which we append, as it places the argument very clearly before the public:—

254.—*Q.* In some cases the policy of the local authorities appears to have been dictated with the view to securing direct employment of the working classes by the local authorities, so that the wages might be regulated under unnatural conditions, that is to say, the representatives of the working classes upon the local councils might have a hand in regulating the wages of their supporters.

A. It has undoubtedly had that effect; I do not know whether it was intended. It is one of the things I have not stated in my examination in chief, but I feel very strongly that one of the worst effects of municipal trading has been that so much labour has to be paid by the municipal authorities who are elected by the very men whose wages they have to pay. The result is most disastrous. All over the country you find wages far above the market rate being paid by municipal authorities, and the British working man being taught to be idle. It is not confined to our industry alone, but has affected our industry very largely. My firm has simply thrown back and refused to take a hundred thousand pounds' worth of contracts given to us within the last year or 18 months as being the

lowest tender, because we would not subscribe to certain labour clauses in those contracts, which, of course, do not occur at all in the case of companies or private firms, and are only put in by local authorities. The clause I allude to is, that every manufacturer must post in a prominent position in his works a notice that he pays the *trade union rate* of wages, and so on. To those who wish to protect the working men who are not trade unionists from the trade unionists it is rather hard; in fact, it is most illogical and most wrong that such things should be permitted, that is to say, that the local authorities should throw themselves in with one division, and that comprising only one-tenth of the whole body of the labourers of the kingdom.

255.—*Q.* Has it been your experience in cases such as you mention that, while British manufacturing firms have not been able to accept the orders owing to the onerous terms of the contract, such orders have been sent abroad?

A. I cannot say personally. It is absolutely the case that more than a hundred thousand pounds' worth of work I had to give up last year, and the year before, for this reason. I do not know whether the orders went abroad or not.

256.—*Q.* But is it not a fact that when orders for plant for municipal purposes go abroad, either to America or Germany, the manufacturers in those countries are outside the sphere of those clauses to which you object?

A. It *is* the fact, and it is a very serious handicap to us.

257.—*Q.* In effect, would you say, from the point of view of the working classes themselves, that the policy which is being followed, ostensibly in their behalf, is a very short-sighted one?

A. Certainly; the whole policy of limiting output has been very disastrous in the past. I think they (the Trade Union leaders) are beginning to see things in a better light now, but it must not be thought that it is the working classes who wish these clauses; it is a few organised bodies of labour who do it, and who number, I think, about one-tenth of the whole body of working men.

258.—*Q.* But the action of some of these local bodies is supposed to be dictated in the interest of labour?

A. It is unfortunately the case that many of the local authorities treat the trade unions as if they did represent the working classes, which they do not.

The evidence of Alderman W. Ivey, of West Ham, and Alderman Pearson, of Bristol, deals with the question from the experience of members of local authorities who do not agree upon the main question of municipal trading.

Mr. Ald. Ivey starts with the obvious principle that all laws should be framed to encourage and develop our national industries, not to restrict them, and logically argues that any Act that does not do so should not continue to be operative, and he points out with considerable force that the practical result of the endeavour of the local authority to protect the community from the birth of a new monopoly has been to create a much worse condition of things by fostering the growth of *a monopoly of inaction* by exercising its right of veto, and so blocking electrical enterprise.

He alludes to the number of provisional orders granted to local authorities, but not worked, and gives the following reasons why this is so:—

1. Want of funds, other demands than electricity having a prior claim due to election pledges.

2. Imperfect knowledge of the subject, business men blocking schemes they think will end in failure, but, we may add, often unable, by their being in a minority on the Council, to prevent fools rushing in where angels fear to tread.

3. The labour question, which entails additional cost, and interferes with ordinary commercial conditions.

4. Areas chosen not by reason of their value for lighting, but for influencing votes at a pending election.

He recognises the necessity for adopting the large area of distribution system for economical supply, and the impossibility of local authorities agreeing to work together as joint authorities on a comprehensive scheme. He sees the advantage of the great power schemes carried out regardless of local boundaries, in removing the evils of the congested districts by facilitating tramways into suburban districts, and thinks that 25 years hence all factories will be compelled to adopt electric power as a cure for the smoke nuisance.

He gives a history of the Corporation electric enterprise in his own borough, proving how they succeeded in delaying a supply from 1889 to 1899, when a municipal supply was commenced, which has been as financially unsuccessful as similar undertakings on the part of most other local authorities.

Mr. Ivey does not appear to be opposed on principle to municipal trading in electricity, and in this respect does not adopt the reasons against it put forward in his paper, as he would authorise provisional orders to be granted to local authorities in the first instance if they are prepared with a counter scheme to the company applying, with a proviso that if they do nothing for 12 months, the Board of Trade may transfer the provisional order to the company which applied in the first instance.

We doubt if Mr. Alderman Ivey's proposal would be practicable. It would be much simpler if the provisional orders were automatically revoked at the end of a fixed period, which would prevent their being sat upon.

We must defer dealing with Alderman Pearson's views until next week.

(To be continued.)

PHYSICAL SOCIETY.

Ordinary Meeting held May 9th, 1902.

Prof. S. P. Thompson, President, in the Chair.

Dr. P. E. Shaw exhibited a "Simple Electric Micrometer." Two years ago Dr. Shaw described an instrument with which he measured very small lengths by the application of electric contacts, and the micrometer shown was a simple form of the original apparatus. A screw, fitted with a milled head, turns in a fixed nut, and its lower end presses upon the extremity of the long arm of the lever. A metal point is attached to the short arm, and the distance through which it moves, on turning the milled head, can be deduced from a knowledge of the pitch of the screw and the ratio between the arms of the lever. In using the instrument this point is always brought up to a metal surface, and the contact is accurately determined by the telephonic arrangement described in connection with the original micrometer. Dr. Shaw illustrated the use of the instrument for measuring small lengths by describing eight applications to ordinary laboratory measurements.

Mr. R. J. Sowter asked if any special precautions had been taken to prevent deformation in the instrument. If not, then it was optimistic to assume that one or more multiplying levers could be used to measure lengths of the order of a millionth of a mm. with any physical accuracy, assuming the multiplication of measurement to be according to the law of the lever, as Dr. Shaw apparently did.

Mr. W. Watson said that the variation of the temperature of the air would distort the lever and produce errors. Dr. Shaw apparently considered the instrument as suitable for laboratory work. If it was for students it was unnecessarily elaborate, and if for obtaining accurate measurements there were objections and uncertainties which should be investigated. A similar form of micrometer had been described by Mr. H. C. Russell, and used in the observatory at Sydney.

Mr. J. M. Barr said that as errors would be introduced by variations in temperature, it might be advisable to make the instrument of a nickel-steel alloy with a small coefficient of expansion. He asked if the knife-edges and screws used were good enough to give the same reading twice, and said he thought the limit of physical accuracy could be obtained by using a single disc on a screw calibrated throughout its length. He considered $\frac{1}{10000}$th of an inch to be about the limit attainable by such methods.

Dr. Shaw, in reply, said that the main justification of the apparatus was in the consistency of the results given by it; these were excellent, as the tables given in the paper showed. This method had been shown to be much more accurate than most of those in general use. Dr. Shaw knew nothing of the prior publication in Australia mentioned by Mr. Watson. Some speakers had suggested that uncertain deformation of the levers might occur during an experiment and vitiate results; but a new strain implied a new stress, and, unless a definite *change* occurred in the forces of the system, we could not suppose a change in deformation. A like answer was given to the criticism that the levers might expand under heat during measurement. Most of the above supposed evils of course existed, but they were of small account. As with every good apparatus ever produced, if ordinary and suitable precautions be taken, these errors were reduced to a lower order of importance and could be neglected. In conclusion, the method had been firmly established in University College, Nottingham, and had superseded other apparatus. It would no doubt spread and become general.

Papers on "The Conservation of Entropy," by Mr. J. A. Erskine, and "Rational Units of Electro-magnetism," by Sig. G. Giorgi, were postponed, and the Society adjourned until May 23rd.

False Doctrine.—We take the following from the "Electrical Catechism" of our otherwise admirable contemporary, *Power*:—

"*Q.* 817.—What is the resistance of a filament?

"*A.*—The resistance of a 3½-watt 16-c.p. lamp for 112 volts is precisely ½ ohm, hot; when cold, the resistance is about 1 ohm."

This marvellous perversion of Ohm's law is enough to make that great scientist turn in his grave. But quite apart from clerical errors, surely the most casual glance at the figure obtained should have revealed its absurdity. The merest tyro in electrical matters knows that the resistance of the ordinary glow lamp is of the order of hundreds of ohms.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1902.

Compiled expressly for this Journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London W.C., and at Liverpool, to whom all inquiries should be addressed.

10,269. "Improvements in electric arc lamps." VERITY, LIMITED, and W. R. RIDINGS. May 5th.

10,271. "Improvements in apparatus for automatically supplying electric power to operate mechanism in clocks and other instruments or machines." H. SCOTT. May 5th.

10,302. "A portable apparatus capable of being concealed by a door-mat or other covering which completes a circuit of electricity when trodden on." J. LANDON. May 5th.

10,335. "Improvements in dynamo-electric machinery." A. H. MIDGLEY. May 5th.

10,342. "Improvements in armature windings and in the method of producing same." T. J. MURPHY. May 5th. (Complete.)

10,369. "Improved electric light switch." J. C. MACALESTER. May 6th.

10,386. "Improvements in and apparatus for the construction of subways and conduits." T. G. GRIBBLE. May 6th.

10,387. "An improved adjustable trolley for electric tramcars and the like." J. REYNOLDS. May 6th.

10,444. "Improvements relating to electric measuring instruments." C. BEEZ. May 6th.

10,452. "Improvements in wireless telegraphy and means therefor." J. E. EVANS-JACKSON. (De Forest Wireless Telegraph Company, U.S.) May 6th. (Complete.)

10,457. "Improvements in storage batteries." J. REDDING, L. D. LOTHROP and I. W. DEERING. May 6th. (Complete.)

10,459. "Improvements in controllers for electric motors." H. J. HADDAN. (D. Bergman, Sweden.) May 6th.

10,460. "Improvements in trolley collectors for traction systems." T. J. MURPHY. May 6th.

10,466. "Electrical appliances for working pile drivers." J. GARVIE. May 7th.

10,473. "An improved glass globe for use with electric glow lamps." G. DAVIS. May 7th.

10,512. "An improved electric conduit." G. W. JONES. May 7th.

10,529. "Improvements in or relating to overhead electric trolley traction systems." J. WATSON. May 7th.

10,532. "Improvements in portable, secondary or other electric batteries, accumulator plates and the like." L. BRISTOL. May 7th. (Complete.)

10,538. "Improvements in or connected with trolleys for use with overhead conductors in electric traction." C. STOLL. May 7th. (Complete.)

10,546. "Improvements in or connected with electric conductors, and attaching devices for lamps or other current takers." J. G. LORRAIN. (H. A. Macdonald, France.) May 7th.

10,581. "Improvements in electric lamps of the Nernst type." W. R. WYNNE. May 8th.

10,590. "Improvements in incandescent electric lamps." G. SWEETSER. May 8th.

10,594. "Cleats for fastening electric wires or cables in casing or other carrying arrangement temporary or otherwise or for permanent fixing to walls, ceilings, roofs, and the like." V. W. RILEY and H. W. ROWING. May 8th. (Complete.)

10,603. "Improvements in switches." W. T. BURBEY. May 8th.

10,672. "Improved electrical firing gear for combustible vapour motors." R. MULLER and R. D. BOWMAN. May 9th.

10,695. "Improvements in or connected with attaching metallic connections to the plates of electric batteries." J. C. FULLER, G. FULLER and D. FULLER. May 9th.

10,701. "Improvements in incandescent electric lamp fittings." A. A. GUEST. May 9th.

10,710. "Improved switchboard for effecting telephonic intercommunication." J. YOUNG. May 9th.

10,733. "Improvements in automatic electric regulating or controlling devices or systems." W. STOCKMEYER. May 9th.

10,755. "Improvements in electrical switches." J. H. TUCKER. May 10th.

10,758. "The speedy trolley wire catcher for electric tramway cars." A. E. BAILEY. May 10th.

10,788. "Improvements in or in connection with wireless telegraphy for signalling between stations, either fixed or moving." C. E. WISNER. May 10th.

10,800. "Improvements in electrostatic instruments." S. Z. DE FERRANTI. May 10th.

10,811. "Rotary carbons for electric arc lamps." A. E. CARTER. May 10th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d (in stamps).

1900.

5,204. "Improvements in towing systems for canals." P. M. Justice. (Columbia and Electric Vehicle Company, U.S.A.) Dated March 19th, 1900. Relates to a system of electric traction on canals in which the current is supplied from the vessel to the tractor-vehicle, which may run on rails or may be a road locomotive. An arrangement is shown in which the current is supplied by a storage battery, but it may be generated by a dynamo. The engine driving the dynamo may also be used to drive a screw by which the vessel is propelled in wide expanses of water, or in reaches where the wash is not liable to cause damage to the banks. The current is conveyed to the locomotive by wires, which may be incorporated in the tow-rope, or may be separate. When separate, they are carried by poles, to allow of one vessel passing another. A winch is fitted on the pole by which the wires may be slackened out or drawn taut.

5,293. "Improvements in lead presses for making plates for electric accumulators and the like." W. P. Thompson. Dated March 20th, 1900. Relates to a roller press or mill for forming ribs or ridges on lead plates. 1 claim.

5,321. "Improvements in plates for storage batteries." H. J. Haddan, C. A. Lindstrom, J. Hewitt and T. Hewitt. Dated March 20th, 1900. An improved method. Relates to a grid for holding the active material in place in such a manner that the active material is continuous from the top to the bottom of the plate. 3 claims.

5,356. "Improvements in or relating to electric cables." R. K. Gray. Dated March 21st, 1900. Single or multiple cored cables have such cores insulated with alternate layers of hard (gutta-percha) and soft or semi-plastic (india-rubber compounds) insulating material. The hard layers are provided with longitudinal ribs. Two or more of the combined layers may be employed together with an external layer and taping.

5,382. "Improvements in step-by-step printing telegraph instruments." L. M. Casella. Dated March 21st, 1900. Printing receivers, in which the type-wheel is rotated by means of alternating impulses acting on a polarised relay, and the printing is effected by means of a prolonged impulse acting on a slow printing magnet.

5,387. "Improvements in apparatus for wireless telegraphy." G. Marconi. Dated March 21st, 1900. Relates to improvements in systems of wireless telegraphy, such as described in Specifications No. 12,039, A.D. 1896; No. 29,306, A.D. 1897; Nos. 12,325 and 12,326, A.D. 1898; and Nos. 6,982 and 25,186, A.D. 1899. The aerial conductors are constructed as two concentric surfaces, or as two parallel wires, one of which is connected to earth, and both are attached to the oscillator at the transmitting station, or to an induction coil at the receiving station. Impedances are included in the circuits as shown for syntonising, the transmitting impedance being capable of great variation for syntonising with any particular receiver of the system.

5,389. "Improvements in and connected with electrically operated railway signals." J. Shoecraft and C. C. Gardiner. Dated March 21st, 1900. Semaphore, &c., signals; signalling and communicating between trains; contacts, electric. Relates to electric mechanism for operating railway semaphore signals.

5,393. "Improvements in trolley poles and standards for electric traction." R. P. Strachan. Dated March 21st, 1900. Relates to electric railways and tramways with overhead conductors. The springs for holding up the pole are placed within the standard above or below the bearings between a fixed standard and its rotary head. A tubular rod is pivoted to the pole socket, and carries an adjustable collar for the spring to bear upon with or without swivelling connections; through this tube a conductor is led. The pole socket may be pivoted to the head, or it may have a sliding pivotal connection by which the leverage is varied as the pole descends. The cap at the top of the standard may be pivoted on the axis of the pole or otherwise, and the top of the swivelling head is flanged and provided with a drainage hole to keep out water. Ribs are also made on the pole socket for the same purpose.

5,394. "An improved method of insulating electrical conductors." E. Zappert. Dated March 21st, 1900. Conductors are insulated with alternate layers of non-hydroscopic and stiffening materials. The non-hydroscopic materials include gutta-percha, india-rubber, paraffin wax, asphaltum, ceresin, &c., and the stiffening materials include paper, yarn, asbestos, vulcanised rubber, &c. These may be treated in various ways, such as impregnating. Insulated conductors may be enclosed in separate lead sheaths, or conductors may be arranged in various ways and enclosed in a common sheathing. Before sheathing, the coated conductors may be dried, and impregnated with ozokerit, ceresin, wax, paraffin wax, Venetian turpentine, oils, resin, and the like. 1 claim.

5,496. "A process for depositing pure tin by electrolysis." E. Quintaine. Dated March 23rd, 1900. For obtaining pure tin from any source, the electrolyte used consists of a stannic salt dissolved in a strong solution of an ammoniacal salt, such as ammonium chloride. 1 claim.

5,528. "Improvements in electric accumulators." L. Gumiel. Dated March 23rd, 1900. The battery consists of a number of trays, all of which, except the top and bottom trays, have compartments for active material of opposite polarities formed on each side of its base. The compartments are formed by intersecting ribs, and the active material on the lower side of the base is held in place by a finely-perforated plate. The upper and lower trays have each only one set of compartments for active material of one polarity. The ribs on the upper and lower surface of each tray are coincident, and are enlarged at their point of intersection, at which place they may be brought into more intimate contact with each other by fusible metal which is poured into dovetail recesses contained in them. The trays are separated from each other by grids of glass, the bars of which are coincident with the ribs of the electrodes. Each tray is filled with electrolyte up to a certain level. 4 claims.

5,561. "Transformer of alternating into continuous currents of equal or different tension." R. Rouge and G. Faget. Dated March 24th, 1900. Relates to apparatus for converting alternating into direct current of equal or different tension, or *vice versâ*. A transformer is shown for tri-phase currents. The primary coils are mounted upon the outer of two concentric cores, a secondary being mounted upon the inner core. The coil is connected to the sections of a commutator over which brushes rotate synchronously with the revolving field produced. The brushes are rotated by means of electro-magnets suitably mounted within the field. There are brushes for collecting the continuous current. The coils may be wound in drum or in ring winding, and may produce bi- or multi-polar arrangements. A construction of machine for carrying out the method indicated above is described in Specification No. 5,562, A.D. 1900. 4 claims.

5,562. "Improvements in apparatus for transforming single and multiphase current into continuous currents and inversely." R. Rouge and G. Faget. Dated March 24th, 1900. Relates to apparatus for converting or transferring alternating into direct current, and *vice versa*. The principle underlying the invention is described in Specification No. 5,561, A.D. 1900. The apparatus comprises two parts:—(1) The fixed part, consisting of the fixed primary and secondary coils, and (2) a movable part for rotating the brushes over the commutator to which the secondary coils are connected. 5 claims.

5,569. "Improvements in or connected with electric storage batteries." W. P. Thompson. (Communicated.) Dated March 24th, 1900. Relates to batteries adapted to traction requirements. 28 claims.

5,585. "Improvements relating to the measurement of electric power and energy in three-phase alternating current and power." R. Arno. Dated March 24th, 1900. Power is measured on a symmetrically-loaded three-phase alternating current system by an induction wattmeter or motor meter, the current coil of which is inserted in one main, while the pressure between the second main and a point on the load between the third main and a neutral connection, such that the lag of the current in the pressure coil due to its inductance is increased to 90° behind the current in the first main, on a non-inductive load. The connection may be obtained on a three-phase inductance connected between the mains. The system may be inductively loaded. 2 claims.

5,593. "Improvements in electricity meters." A. Wright. Dated March 24th, 1900. Relates to quantity meters. More particularly to mercury voltameters, such as are described in Specification No. 2,222, A.D. 1900, are provided with various improvements.

5,649. "Improvements in and relating to telegraphic apparatus." S. G. Brown and J. A. L. Hearlove. Dated March 26th, 1900. Relates to arrangements especially for submarine working by duplex and other systems. The relay, such as described in Specification No. 1,431, A.D. 1899, are preferable coupled up by means of insulating springs, to a second heavy damping coil, which may be double-wound and arranged in the relay circuits so as to emphasise the signal currents otherwise distorted by the charging of the condenser. The relay coils may be arranged to oppose or strengthen the motion of the main coil, and may be supplied with current from the relay circuit, the cable, or from an independent source. In the case of duplex working, the cable and artificial line are bridged by a coil mounted on an iron core, and forming the primary of a transformer of which the secondary bridges the receiver, the transmitter being connected to the middle point of the primary. Multiple-point switches are provided for varying the points of connection of the circuits, to obtain balancing, with means also for adding extra resistance to the primary. Resistances are also bridged in between the cable and receiver and artificial line and receiver. In the case of resistances being employed to shunt the condensers, the Provisional Specification refers to connecting the relay tongue to its coil by a liquid connection, by magnetic arrangements, or by frictional mountings adjusted by mechanical or electrical oscillating devices. 1 claim.

5,767. "Improved construction of carrier for globes or glasses of electric, gas or oil lamps." E. Stanley. Dated March 27th, 1900. In electric gas, and oil lamps, the entrance of water or liquid is prevented by clamping the flange of the globe, between india-rubber or asbestos washers, the globe being secured by semi-circular jaws which are pivoted to the body, and are clamped by a screw passing through slots in the thinned ends of the jaws. When the invention is applied to upright, instead of to pendant lamps, the body is formed with an internal flange to intercept liquid. 2 claims.